ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXIII. No. 23.

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ENGINEERING NEWS.

THE FIRST DREDGE for the Nicaragua Canal sailed from Charleston, S. C., May 28. Three others will follow within 40 days. These are all for the harbor dredging work, and not for the main channel of the canal, the dredging for which cannot be economically pushed till work on the great divide cut is well advanced. The railway to reach the latter, for which Mr. CHAS. P. TREAT has the contract, is being pushed as fast as possible, and is likely to be finished early in the fall.

THE MARYLAND AND DELAWARE SHIP CANAL PROJECT is again revived, and there is talk of an early commencement of work. The enterprise is said to be in the hands of a French company, with $8,000,000 capital. The route selected is the Sassafras route of B. H. LATROBE, C.E., surveyed in 1874. It would begin at the Sassafras, on Chesapeake Bay, 39½ miles from Baltimore; then up that stream 16¼ miles; then through a country with 80 ft. maximum cutting above low water and down the valley of the Black Bird Creek. It finally passes through a ridge of high ground, and would enter Delaware Bay near Liston's Point. The solid cutting is only 7¼ miles, and the whole distance between navigable water on both sides is but 14¼ miles. Mr. RICHARD J. CAPRON and Mr. W. J. ROE, of 35 Broadway, New York, represent the canal in this country.

THE BREAK IN THE ERIE CANAL of May 25, was in the tow path about one mile west of Whitestown. The width of the break is reported as being "12 rods," and the track of the New York Central railroad was washed away, and a freight train was wrecked by failing to observe the danger signals. The break will stop navigation for a week or more, and the damage to canal and railway property is very considerable. The canal is now empty for nearly 60 miles. As there is also a bad break on the Champlain Canal the stoppage of both canals at one time is a serious matter, and owing to "the worry and responsibility thrown upon him" by recent changes in the class of his subordinates, Mr. A. S. C. WURTELLE, Deputy State Engineer, is reported to have resigned his office.

THE BOSTON WEST-END ELEVATED RAILWAY BILL has been ordered to a third reading by an almost unanimous vote of the Massachusetts Senate. Its friends are jubilant and consider the victory won.

THE NEW YORK RAPID TRANSIT COMMISSION must send in its report by June 22. At a late meeting Mr. WM. E. WORTHEN was appointed Consulting Engineer to the Commission, and has accepted. A route is about decided upon from 42d St. to City Hall, via Fourth Ave. Lafayette Place, Elm and Centre or Mulberry Sts. The crossing of City Hall Park is an obstacle to the Battery extension. A loop at Reade St. and then down William St. has been suggested; but William St. is too narrow for a four-track road, the only one now under consideration. Mr. JAMES H. GREATHEAD, the engineer of the new Thames subway in London, has submitted a proposition for a tunnel 40 to 60 ft. below the surface, with hydraulic elevators at the stations, etc. Another tunnel scheme was offered putting the cost at $36,000,000, an amount deemed much too low by the chairman of the board.

The plans so far considered call for a four-track road, with the two inner tracks depressed 5 or 6 ft. below the outer ones, so that passengers can pass under them to the platforms. Elm St. plays an important part in the scheme. As to the Harlem route, Madison, Lexington and Fifth Aves. are open to the Commissioners; but they do not think of occupying the latter, and Lexington Ave. is only 35 ft. wide between curbs. No decision was rendered as to Madison Ave.

THE BROOKLYN BRIDGE PROBLEM is discussed in a long article in a recent number of the *Centralblatt der Bauverwaltung*. After illustrating the present method of handling the cars and describing the Wellington and Emery plans, it discusses the proposed system of Engineer MARTIN and concludes as follows: "As may be seen from what has been said, the danger is in no way diminished by this plan but rather increased, both on account of the many crossovers and the surrounding of the platforms by tracks, which will hardly allow a crowd to be handled in a panic."

THE RIVALRY BETWEEN THE PENNSYLVANIA R. R. and the Baltimore & Ohio-Reading-New Jersey Central combination in the lines between New York and Washington has led the latter to determine to do away with all the old cars on the New York line, replacing them with new ones. The line will be known as the Royal Blue Line, from the color of the cars. The three companies have ordered the cars from the Pullman Co. of Chicago. There will be sixteen passenger coaches, eight combination cars for baggage and passengers, and ten parlor cars. Each train will consist of four or five cars. Each car will be vestibuled, and will have a smoking apartment for twelve persons. The cars will be lighted with gas and heated with steam, and will have automatic brakes. There will be no extra charge for travel in these trains, except for seats in parlor cars and berths in Pullman sleepers. The expenses of equipment is to be borne equally by the three companies.

THE WORST ACCIDENT OF THE WEEK in every sense was the terrible draw bridge disaster at Oakland, Cal., the Brooklyn of San Francisco, Friday, May 31, by which 13 lives were lost and a number injured. By the thoughtfulness of a San Francisco subscriber, we are enabled to give very correct details of the occurrence in another column. It appears have been the result of pure and unadulterated recklessness, resulting from a careless system of operating.

A SERIOUS ACCIDENT OCCURRED ON THE OHIO RIVER R. R. last Thursday. A train containing a number of Baltimore & Ohio R. R. officials jumped the track near Clarington Station, W. Va., and was precipitated over a trestle, turning upside down in the fall. Several of the occupants of the car were injured, among whom were the following B. & O. officials: A. H. Johnson, Chief Engineer Maintenance of Way; J. F. Legge, Superintendent Western Division, John Hock, Superintendent of Bridges, Ohio River R. R., and A. Walter, General Superintendent, B. & O. R. R.

SECTION 4, NEW CROTON AQUEDUCT, Brown, Howard & Co., has been accepted as complete by the Commission. A sum of $65,109 is withheld until the Corporation Counsel shall report upon the provisions of the "time limit" in the contract. The fact that the contractors were ordered to line the tunnel after the original agreement was made is considered a valid excuse for some delay. Sections 7 and 8, O'Brien & Clark, await the same decision, and about $158,000 is kept back for these sections in like manner.

THE GUNNISON RESERVOIR, nine miles from the town of Gunnison, Col., burst on May 21. The accident was caused by leakage along the pipe used for draining the reservoir. The reservoir was 5 miles long, about 1¼ miles wide and nearly 20 ft. deep. As the warning was ample no lives were lost, as far as now known, but the destruction of property will be great.

THE FRUIT HILL RESERVOIR, at Providence, R. I., is just now the subject of serious consideration by Commissioner COLEMAN. He has had it emptied and, according to the Providence *Journal*, found that the walls were giving way on three sides, and "there were holes in the granite big enough to drive a horse through." He says the damage is due to faulty construction on Mr. GRAY'S plans, and under a contractor chosen by him. He is going to ask for a "large sum" for repairs. On the other hand, Mr. SAMUEL M. GRAY, the late City Engineer, said that he examined the alleged damage, found a settling of the slope wall not exceeding 1 ft. in one or two places, and he estimated the cost of repairs as not exceeding $500. The plans for the reservoir were approved by Mr. JAMES B. FRANCIS, one of the most eminent of our hydraulic engineers, after the most careful study by Mr. GRAY and himself, and the work was done under an inspector appointed by Commissioner COLEMAN, and it was visited almost daily during construction by Mr. COLEMAN himself. Our readers must decide between these authorities in the light of the bitter personal controversy going on between Mr. COLEMAN and the late City Engineer.

A NEW WATER SUPPLY FOR PARIS is under consideration and has been approved by the committee of experts to which it was submitted. At present Paris has two independent supplies—31,000,000 galls. per day of spring water, for domestic purposes, and 100,000,000 galls. daily of river water, for manufacturing and municipal use. The domestic supply must be increased to meet a demand of 22 galls. per head for 2,500,000 people. The supply now being discussed would come from the river L'Avre, in Lower Normandy, 62 miles from Paris. It would be a gravity supply, with an available head of 328 ft. at Paris (above the Seine). The conduit proposed is circular pipes 5 ft. 8 ins. diameter, covered outside by 5 ins. of brick and lined inside with ¾ in. of cement over the lower two-thirds. The grade would be 2 ft. per mile, giving a velocity of 3.3 ft. per second. This aqueduct would discharge into a new reservoir at Montretout, with a capacity of 88,000,000 galls.

THE HAMBURG-AMERICAN STEAMER *Normannia* had a narrow escape from destruction by ice on her maiden trip across the Atlantic. The iceberg was suddenly encountered in a gray mist, dead ahead and a few ships'-length distant, with the steamer rushing on to it at a 17-knot speed. Orders quickly given and twin screws saved the ship by turning the 10,000 ton mass as on a pivot. She was grazed by the side of the berg, however, and the starboard turtleback was crushed in by the fall of some tons of ice. The *Normannia* is 520 ft. long, 60 ft. wide and 40 ft. deep. She has triple-expansion engines, with cylinders of 40, 67 and 106 ins. diameter respectively. The hull is divided into 17 water tight compartments, and the skin is double and with a 4-in. space between, except under the engines, where the space is 7 ft. This double skin is divided into 36 compartments for water ballast.

THE *Vesuvius* was formally taken possession of by the U.S. Government on June 2 at the League Island Navy Yard, Philadelphia.

THE PHILADELPHIA DEPARTMENT OF PUBLIC WORKS has been authorised by Councils to spend, for 1890, $2,070,000, divided as follows: Extension of gas mains, $100,000; repaving railway streets, $75,000; repaving other streets, $180,000; main sewers, $240,000; Walnut St. bridge, $275,000; Roxborough reservoir, $400,000; new schools, $300,000; temporary loan, $500,000.

BRICK PAVING has been thoroughly tested in Galesburg, Ill., and is pronounced a success after six years trial with about five miles laid. Three

manufactories there now make paving brick, turning out about 160,000 daily and employing 400 men. The clay is exceptionally good and is ground up and sifted as fine as flour and then moistened, moulded and burned in a close kiln with a downward draft. From one-fourth to one-third more time is consumed in burning than with the ordinary brick. In burning the brick shrinks from 9 ins. in length to 8 ins. and proportionately in other directions. It is thoroughly vitrified throughout and weighs about 5 lbs. This brick will resist the best steel drill and a chip "will cut glass."

In laying, the street is properly graded and covered with 4 to 5 ins. of macadam, then 4 ins. of sand is put down and wet down thoroughly and levelled. Then one course of brick is laid down flat and lengthwise with the street and rolled with a light roller; on this course is placed 1 in. of sand, and then a final course of brick is laid on edge and across the street; a half-inch of sand on top fills the crevices, and the whole is well rolled. The street is graded with a fall of 6 ins. in 19 ft. from the center. This fall is carried to within 3 ft. of the curb, where it is level to within 1 ft. of the curb and then rises 1 in.

This pavement has stood the test of the severest traffic of the town, in some cases for six years; shows no wear and has cost literally nothing for repairs. As to price, the contractors were required to do the grading, furnish sand and all other materials, except only the guttering, and make the pavement complete, and all this they do for $1.40 per yard. The paving brick sell at Galesburg for $8.50 per 1,000 on cars, and the price is shaded to $8.25 per 1,000 on large contracts.

THE SIMPSON DOCK AT NORFOLK has not settled, as was at first reported. The Board of Naval Engineers convened to make the examination, docked the old 4,000-ton frigate *Franklin* to test the stability of the work. They report that there was no distortion of the floor during the test, though there was a slight settlement due to the compression of the timbers. The dock is in good condition and no repairs are necessary.

THE KHOJAK PASS TUNNEL, recently finished, on the Indo-Afghanistan line, is 7,500 ft. above the sea. The length is 12,600 ft. and it is designed for a double track. The chief obstacle in driving was the cutting of springs of water.

PNEUMATIC TUBES FOR POSTOFFICES just now occupy the attention of Postmaster-General WANAMAKER. It is believed such a system could be introduced with advantage at the large postoffices of the country to connect them with sub-stations. It could also be used to connect all the buildings of the executive departments in Washington and the capitol to facilitate business, which is very large. If Mr. WANAMAKER becomes convinced that it is a good thing, he will call the attention of Congress to the subject and ask for an appropriation.

CHICAGO FAIR DETAILS are being very actively discussed locally, but nothing will be positively determined about either site or buildings for some little time yet. The battle for the site is a keen one, and is likely to continue so. The most sensible suggestion yet made is to allow subscribers for the $5,000,000 stock yet needed to be taken vote on the site question, one vote for each share taken, and subscriptions to be binding whatever the decision. "Put up or shut up" would then have to be the motto of the site boomer, while even if the whole $5,000,000 were taken by partisans of one site it would not necessarily ensure its being taken unless found suitable.

LONDON STREET TRAFFIC has been tallied by a Parliamentary committee, with the following results: On Feb. 11, 1890, 11,558 carriages and 72,645 pedestrians passed through Cheapside. On April 1, 11,877 carriages and 87,274 pedestrians passed by Mercer's Hall, and on the following day 13,500 carriages and 101,940 pedestrians passed Saddlers' Hall. On Feb. 13, 13,316 wagons and 96,228 pedestrians went through Foster's Lane, and on the previous day, in Roman Bath street, these figures were 10,532 and 44,314 respectively. On April 1, 11,556 carriages and 47,070 pedestrians passed along Newgate street. On Feb. 11, between 8 A. M. and 8 P. M., 14,301 carriages and 59,455 pedestrians passed Holborn Bars.

The Crib Structures of New Brunswick.

The "crib" railway bridge, here illustrated, is taken from a photograph made by Mr. O. J. OSMAN, consulting engineer of the Salisbury & Harvey Ry. Co., and kindly sent us by Mr. CHARLES R. SCOLES, manager of the company, Hillsboro, N. B.

This "crib" is 480 ft. long and about 80 ft. high, and is built of pine logs, starting with a base of 50 ft. in width and finishing 12 ft. wide at the top. It was built about 14 years ago, contains about 6,000 large logs, and must have cost twice as much as the trestle with which it is now being replaced. A gothic arch of very primitive design spans Turtle Creek, and a square opening to the left of this arch carries a roadway beneath the crib.

The structure is, perhaps, the largest existing example of a type of "bridge" very common throughout New Brunswick, and almost universal for highway bridges across valleys. When built of cedar, as most of the earlier "bridges" of this type were, it is exceedingly durable, but in default of cedar, pine and all other kinds of lumber are used. In this case the structure becomes a somewhat treacherous one, but it has this redeeming quality, that decay is likely to be greatest near the bottom and to give warning by gradual settlement. In fact, most of the structures on highways are so old that they have decayed and settled considerably, and still continue to be used. When they become too bad even for a country road supervisor, a new crib is generally built alongside the old, and the old one abandoned altogether. It is, of course, all but impossible to repair a structure of this kind without starting anew from the foundation.

A Crib Bridge over Turtle Creek on the Salisbury & Harvey Railway, near Salisbury, New Brunswick.

As illustrating how a bad practice will spread and intensify itself, the first use of small cribs on highways was proper enough, as we have said. When railways began to be built, the same type was, much less excusably, used for them, as this drawing illustrates. When the Intercolonial Ry. came to be built—an enormously costly government road, built through the wilderness for political purposes—the same type was, still less pardonably, used as the base of embankments where the toe was exposed to the wash of rivers. The whole base of the banks in these cases was not of "crib-wharfing," but it extended far under the bank, and was often of much steeper slope than the bank outside. Still, the cribs were usually of cedar, well battered, protected on the outside by riprap, and not extending so very far under the bank. Had they not been supporting the bank, but a mere external wire protection, they would have been altogether admirable.

Soon after the Intercolonial was finished, however, the Canadian government started work on the Pacific end of the Canadian Pacific. The old Intercolonial engineers were largely sent out to build it. The new line was no longer down near the beds of rivers, but high on the sides of frightful cañons. There was no longer durable timber available, but only very perishable timber. There was no longer probability of most of the timber being at all times wet, but a certainty that none of it would be wet for months together, the line lying through an almost absolutely rainless region. What did the government engineers do, however, but copy the Intercolonial practice of using crib-wharfing on a much larger scale, and with a disregard of safety which made the "crib wharfing" (the very term will be a new one to most of our readers) as monstrous examples of reckless and dangerous construction as ever disgraced any railway in any part of the world; albeit this was on a government work, and the government was under a triple obligation to make all its work fairly good and safe; in that it had no excuse of pecuniary necessity, was bound to set private individuals a good example, and was bound in good faith to build the road as well as if it was to operate it itself, since the building of this costly section as a free gift was a part of the consideration for which private enterprise undertook to carry through the Canadian Pacific Ry.

It is not conceivable that the government engineers realized how greatly they were violating these obligations. They were simply acting from force of habit formed on the Intercolonial; but what they did was to use crib-wharfing in lieu of retaining walls in ground so steep that no man could even climb up it unaided, hundreds of feet up the side of the cañon, of perishable timber, extending to within two or three feet of the track, and so covered up that it was impossible to tell what the real condition of the timber was without tearing the crib all to pieces. The Canadian Pacific naturally protested against this and other like defects of construction, and a great arbitration case resulted, involving some $6,000,000, which has been going on for two years, and is not yet settled.

We should have mentioned, perhaps, that there had been an intermediate step, tending to make it still easier to so abuse the use of timber. Before the railway work was begun, the British Government had built a wagon road up the Frazer Cañon. A number of the Intercolonial engineers were in this, and crib-work was largely used for it; a use which was perhaps justifiable for a wagon road under all the conditions, but which certainly afforded no justification for extending the same support to the roadbed of a railway.

As a matter of fact, what took place with these cribs was that they rotted at the heart, where the timber was covered up, until they became nothing but punk, while yet the exterior of the crib seemed to be, and was perfectly sound. Thus the danger was at points very great, but extreme watchfulness has averted disaster, and will doubtless continue to do so until all these cribs supporting side-hill banks have been removed.

An Experimental Study of Air Resistance.*

BY O. T. CROSBY.

(*Continued from Page 507.*)

Reaching the question of actual determination of values, it is to be remembered that a majority of the experimental determinations of resistance under given conditions are reported in the shape of formulæ involving V, D and A, with a constant coefficient.

Inquiring into the methods used for these determinations, it is found that they have been:

(1) For very high velocities, as in ordnance practice, by measurement of initial velocity and actual trajectory, hence calculation of available energy and resistances overcome.

(2) By observed fall of bodies of known weight and resisting area.

* A paper read before the West Point branch of the Military Service Institute.

(3) By drawing bodies in a rectilinear path through air or water.

(4) By swinging a pendulum.

(5) By exposing bodies to impact of wind or artificial blast, or flow of water currents, measuring pressure by spring movement or otherwise.

(6) By whirling bodies through air around a center.

Results from (1), in so far as applied to the particular projectiles and velocities chiefly used to determine the formula entered, are reasonably accurate. When reduction to low velocities and to a normal plane front is attempted, divergencies are to be noted. No account is taken of supposed length of projectile in making this reduction.

(2) No considerable series of experiments by falling bodies is on record—NEWTON used this method.

(3) Experiments giving rectilinear motion have been limited to very low velocities and made chiefly in water.

(4) A number of very delicate experiments, at low velocities, have been made by swinging the pendulum. Prof. ABBE says: "These phenomena would afford a very accurate means of determining the resistance of the air were it not for analytical difficulties in determining the effect of the varying action of the pendulum during each oscillation.

(5) A great number of impact experiments have been made both in air and water. So far as the determination of pressure-velocity relation is concerned, they all suppose a knowledge of that relation, or suppose that in some way the velocity of impact can accurately be given. Some accuracy on this point may be obtained by the method of artificial blasts, but none worthy of consideration in exposing to the wind. Much dissatisfaction is expressed by many authorities with the best forms of anemometers—even considering their function to be only that of indicating relative velocities and not absolute measurement in miles per hour, feet per second, etc.*

(6) In whirling machines the velocity of the moving body may, of course, be determined with accuracy. True relative velocity is subject to slight error of determination due to disturbances in originally still air, caused by motion of the solid. Measurement of pressure against the solid is usually complicated to a considerable degree by the necessity of eliminating work of friction. This method, however, with modification of detail, has been adopted by many experimenters, especially those working in air.

I had intended to turn a wheel at a very high velocity by an electric motor, wherein the output of mechanical energy can be quite accurately measured. The apparatus actually used and described below was in the main proposed by Mr. DASHIELL, my assistant in the general work leading to this experiment.

Description of Apparatus.—The room in which the whirling experiments were made was 40 ft. long, 19 ft., wide over one-half its length, sloping to 13 ft. width across the engine. The height to rafters was 12 ft., with hip roof having 7 ft. rise. There were six windows, opening about 9 sq. ft. each to free air on three sides of the room; also, one door opening about 20 sq. ft. A similar door opened into another room, itself communicating with open air, and a third double door, about 40 sq. ft., communicated with a third room opening into free air. Most of these doors and windows were continually open during the experiments. The closing of some of them seemed to make little if any difference in the interior movement of air.

The apparatus consisted of a 90 H. P. steam engine, whose speed could be regulated to half a revolution, or even less. Its normal work was the driving at 300 revs. per minute of a 70 H. P. dynamo. This engine was belted to a pulley set on a vertical steel shaft 6 ft. 6 ins. long, running in socket bearings above and below. On this shaft were four collars, two near the top and two near the bottom. Of these two sets, one was keyed, the other loose. The two keyed collars were attached to a system of iron rods forming a triangle, the rods from the upper collar meeting those from the lower collar in the horizontal plane passing through the latter.

At their intersection they carried a two-prong casting, against which rested the spring transmitting the atmospheric pressure; here was fixed also a wooden plate, to which was attached the card on which the spring movement was recorded. The loose collars were likewise attached to a system of iron rods, two of which (those in the horizontal plane of the lower collar) passed through the middle of the miniature cars, those from the upper collar being bolted to the top of the car, thus preventing any sag due to weight. The length of the radius thus constituted was 5 ft. 6 ins.

To the rear of the car was bolted a plate having a central socket. A rod extended from this socket through the forked casting above referred to; back of this casting the rod carried washers and a nut. Over the rod a piece of pipe fitted loosely, and over this, also loosely, the spring, about 8 ins. long. The surface of the pipe was well oiled. Springs of three different values were used :

No. 1.....Compression of 1-16 in. = 84 lbs.
No. 2 .....Compression of 1-16 in. = 1.56 "
No. 3.....Compression of 1-16 in = 3.29 "

To the rear of the car was attached an arm carrying a pencil having spring contact with the card above mentioned. When the shaft moved, under the belt effort, the fixed collars and attached rods pushed the car and carrying rods forward; the resistance of the air was then measured against the elasticity of the spring, the friction of the pencil on the card and the friction of the collars on the shaft. These frictional resistances were scarcely appreciable. A slight effort of the finger would continue a steady motion. Its absolute maximum value is now known to be not more than .02 lb. applied at the circumference of the circle of revolution.

When the larger bodies (2 sq. ft. cross section) were in position, the lower surface was 2.5 ins. above the platform; with the smaller bodies (1 sq. ft.) this distance was 5.0 ins.

[TO BE CONTINUED.]

*For fuller information on the subject of anemometers in general see Prof. ABBE's Report to Chief of Signal Service, 1887, and article "Anemometers" in Enc. Britt.

The Desirable Efficiency of Hydrants in Connection with Water-Works.

Among the papers giving good advice read at the Chicago Water-Works Convention, was one with the above title, by Mr. EDWIN DARLING, Superintendent of the water-works of Pawtucket, R. I. We make an abstract of this paper as follows:

In the first place the mains should be of a sufficient dimension to supply with ease the hydrants placed thereon, and they should never be less than 6-in. inlets. It is a well-known fact that four good fire streams are all that can be expected from a 6-in. main.

Another mistake that is made is in locating hydrants too far apart, where you have mains of sufficient magnitude to supply. Hydrants are cheaper than hose and will last longer with less care; besides you obtain better results with short lines of hose. The friction in the hose overcomes the pressure, and the effectiveness is lost to a large extent. The relative cost of the life of the hydrant in comparison with the life of the hose is largely in favor of the closeness of hydrants. The hydrant costs money; but admit that they do, what is the cost of a hydrant in comparison with its worth when you want it.

The hydrant is looked upon by some as a useless thing because it is not used, or in other words because we do not have fires. We have on our works hundreds of hydrants that have never been opened for fire purposes in the last ten years, and yet I would not know where to discard one; in fact we do not wish to use them until we have a fire, and then they are wanted very badly. We never want a fire; it is like the insurance on our houses; we pay, but do not want them to burn. I remember a few years ago some of our citizens said we did not use them and therefore ought not to pay for them. About that time we had a large lumber yard on fire, it was a very dry season and the wind was blowing in a direction which carried the sparks over the business part of the city. At one time the roofs of sixty buildings were on fire. The hydrants were brought into service, playing fifty-two fire streams in that location, and in connection with the sill-cocks, which nearly every house has for garden hose, a conflagration was prevented which might have cost a million dollars. These same people admitted after that that there were no useless hydrants in the city. All hydrants should be easy of access, and should be used only for fire purposes, except in case of necessity. Some cities allow them to be used for sprinkling-carts, or watering down the streets, and other purposes, by inexperienced men. As a result the firemen find them out of order when wanted, and the Superintendent has to stand the blame. They should be inspected as often as twice a year and properly oiled, but never inspected in extremely cold weather, as by the introduction of water they are liable to stick with frost. Of course there are certain kinds of flush hydrants that have to be looked after in extreme cold weather more frequently. With an experience of 10 years with from 400 to 800 hydrants we have had but little trouble with frost. Ours are post hydrants with rubber disks and shut against the pressure, and I have never had to remove one as yet.

In conclusion, I contend that builders of water-works should always remember that the efficiency of the hydrants is of the utmost importance, and they should always be looked after with the greatest care. Superintendents having charge of works, in making extension, should always try to connect all dead ends, so as to reinforce the supply to the hydrants, and make them more efficient as their works increase in magnitude.

In the discussion which followed the paper it was brought out that the water used for fires during the year averaged less than 1 per cent. of the annual supply. Mr. OWEN had figured that the average amount of water required to extinguish a conflagration was 75,000 gallons.

A List of the Abt Railways in the World.

Mr. W. HILDEBRAND, C. E., representing the Abt system of rack railroads in the United States, gives the following as a complete list of their roads now in operation:

	Miles.	Per cent. grade.
Bankenburg-Tanne, Harz Mountains, Germany	4.6	6
Puerto Cabello, Valencia, Venezuela, S. A	2.3	8
Lehesten, Bavaria, Germany	1.0	8
Oertelsbruch, Thuringia, Germany	½	14
Eisenerz, Germany	9.0	7 1
Visp-Zermatt, Switzerland	2.2	12.5
Ostrazac-Serajewo, Bosnia, Austria	12.4	6
Bolan Pass, East India	12	5
Mendoza-Santa Rosa, Trans-Andes Railroad, S. A	...	...
Mt. Generoso, Italy	5.6	22
Manitou-Pike's Peak, Colo. (in course of construction)	9.0	25

These last two roads are principally for tourist cars.

The Progress of Continuous Steam Heating of Passenger Trains.

That the adoption of a safe, convenient and economical method of heating passenger cars is one of the live topics of the day in railroad circles will be admitted by any one who examines the map and list published with this issue of ENGINEERING NEWS showing the progress which has been thus far made in this important reform.

As shown by our map and table, on 8,465 miles of railway *all* passenger trains run during the winter of 1889-90 were heated by steam from the locomotive. Companies operating 10,912 miles more have *over half* their cars equipped for steam heat. Companies operating 17,516 miles have from *ten* to *fifty* per cent. of their cars equipped, and companies controlling 54,550 miles have begun the "experimenting" process which about every master mechanic deems it necessary to conduct for himself without relying on the experience of others; and have 10% or less of their cars equipped for steam heating.

This makes a total of 91,443 miles controlled by companies which have made at least a beginning in this important reform. But even this excellent exhibit of progress does not fully represent the advance which has been made, since the roads which have advanced furthest in the matter are mostly those having a heavy passenger traffic. The real state of the art is much better shown by the total number of cars equipped, which as shown by our table is no less than 7,391, or nearly *twenty-five per cent.* of the cars used in passenger service in this country, estimating the latter at 30,000 cars. By the last issue of *Poor's Manual* it is 28,252.

The accompanying table gives statistics for 86 different companies. For 58 of these our information was obtained directly from officials of the companies. Statistics for the remaining roads were obtained from the reports of State Railway Commissions or from the principal companies which equip cars with steam heating systems. The data furnished us from the latter source convinces us that practically all the steam car heating of the past winter is shown on the accompanying map and table. The only companies we have been able to find which are doing anything at all in steam car heating, not included in the table, are the Ohio & Mississippi, Mexican International, Canada Atlantic, Jacksonville, Tampa & Key West, Canadian Pacific, Kansas City, Wyandotte & Northwestern, Louisville & Nashville, Quebec Central, Mexican Central, Atlantic Coast Line, Savannah, Florida & Western and Western Ry. of Alabama.

TABLE SHOWING PROGRESS IN HEATING PASSENGER CARS BY STEAM FROM THE LOCOMOTIVE.

Name of company.	Mileage operated.	Total cars in passenger service.	No. of cars equipped for steam heating.	No. of steam-heated trains run during winter of 1889-90.	What company's system or systems is in use?	Kind of coupler used.	Difficulties in operation.	Does draft on locomotives cause appreciable increase in fuel consumption?	No. of cars to be equipped before n'xt wint'r	System expected to be adopted for these cars.	Type of coupler to be used on these cars.	No. of cars heated by separate heater other than common stoves.	No. of cars to be equipped with separate heaters before next winter.	
New England Railways.														
Bennington & Rutland	59	18	6		Consol.									
Boston & Albany	388	319	250	All.	Martin	Martin	None.	None.	None.			66*	None.	*Baker and Johnson heaters.
Boston & Maine	1,208	789	232		Consol, 227; Kimball, 5	Sewall						449		
Boston, Riv. B. & Lynn	14	45	29	All.	B., R. B. & L. R. R. Cos.	B.,R. B. & L. R. R. Cos.	None.	None.	Indef.					
Central Vermont	705	146	15	5	Consol; Martin & McElroy	Sewall; Martin & McElroy.	None.	None.			Sewall, if any.	30*	None.	*Baker fire-proof heaters.
Cheshire	80	37	12		Sewall	Sewall	None	None.						
Conn. River	127	61	50	All.	Emerson	Emerson	None.	None.	6	Emerson	Emerson	1	None.	
Fitchburg	369	220	220	All,	Sewall	Sewall	None.	None.				None.		
Knox & Lincoln	50	13	10	*	"									*All except mixed trains on branch lines.
Maine Central	742	147	130	55	Consol	Sewall,	None.	V'ry slight			Sewall, if any.	17		
New London No'n	121	28	16		"	"	None.	Impercep.				5		
N. Y. & N. E	490	210	174		Consol., 29; Safety, 144	"						83		
N. Y., Prov. & Boston	132	136	70	14	Martin; Consol ; Safety	"	None.	Appre'ble*	66	Our own direct; consol. for indirect.	Sewall	50	10	*No difficulty about having steam enough.
Old Colony	587	489	166	263	Sewall; Gold; Richards	"	Yes.*	10% in.†				271		*Regulating heats and warming at terminals. †Estimated for very cold weather.
Portland & Rochester	52	16	12		Sewall									
Prov., Warren & Bristol	15	20	20											
Rumford Falls & Buckfield	27	5	5		Sewall									
Somerset	41	5	3	1	"	Sewall	None.*	None.	2			2		*As compared with common car stove.
Total	5,207	2,704	1,420									964		
New York Railways.														
Buff., Roch. & Pitts	284	40	28	6	Martin	Martin	Yes.*	None.	4	Martin	Ball joint			*Difficulty in regulating temperature.
Cent. N. E. & W'n	145	36	36	All.	"	"	Yes.*	None.		"	Metallic	None.	None.	*Difficulty in regulating temperature; drip freezing on air coupling; leaking at coupling.
D. & H. Canal Co ; Northern Division	436	112	112	All.	Consol	McElroy	None.†	None.				69*	None.	*Baker heaters used, with steam from locomotive. †Can keep temperature in cars at any point desired.
Penn. Division	156	32	30	All.	"	"	None.	None.	4	McElroy	McElroy			*With some of our own features.
Dunk., All. Val. & Pitts	91	12	12	All.	Martin*	Martin	None.				Metallic			
Elm., Cort. & North'n	140	17	8		"	"	None.	None.	Indef.			None.	Indef.	
Fall Brook Coal Co.	280	32	32	11	"	Gold; Martin	None.	None.				1	None.	
Kings Co. Elevated	6	130	130		"	Martin								
Lack. & So'w'n	90	13	5	1	Gold	Gold	None.	None.	All.	Gold.	Gold.			
L. S. & M. S.	1,499	285	163	20	Martin; McElroy; Erie	Martin	Yes.*	Yes.†	Indef.		Hose	105	None.	*Couplings leak and traps occasionally freeze. †Where train exceeds 8 cars.
Long Island	356	236	236	484	Gold; Martin	Gold; Martin		About 6%	23			None.	None.	
Manhattan Elevated	32	918	918	2,730	Gold	Gold	Yes.*	3% increase						*Difficulty in preventing freezing when the trains are laid up.
N. Y. & No'n	61	42	35	7	"	"	None.	None.	None.					
N. Y. C. & H. R. (including West Shore).	1 420	1,077	1,077	All.	Martin	Martin								
N. Y., Chic. & St. L.	524	50	12	2	Erie	Erie	None.	None.	38			1	Indef.	
N. Y., L. E. & W'n	1,820	680	630	All in N.Y.	N. Y., L. E. & W; Safety; Martin.	McElroy	None *	None.	50	N.Y.L.E & W.	McElroy	110	Indef.	*None whatever with direct steam, and but little with combined system.
N. Y., O. & W.	424	94	60	12	N. Y., O. & W.; Standard.	"	None.	None.	8	N. Y., O. & W.	"	7	None.	Will equip remaining cars with system now in use
Northern Central	147	35	35	8	Martin	Martin	Yes.*	None.						*Difficulty in regulating temperature; leak at couplings.
Pa., Pough. & Boston	95	15	15		"	"								
Rome, Wat. & Ogdens	655	141	113	30	R., W. & O.; Standard	McElroy		None.	50	R. W. & O.	McElroy	None.	None.	
Staten Island R. T.	80	38	38	8	Gold	Gold	None.	None.	None.			None.	None.	
Suburban R. T.	3	26	26	7	"	McGee	None.	V'ry little.	Indef.	Gold	Gold			
W'n N. Y. & Pa	632	92	55	18	"	Gold	None.	None.	30	"	"	None.	None.	
Total	9,226	4,153	3,806									293		
Other Railways East of Chicago.														
Allegheny Valley	259	51	8	4	Consol.; Gold; Martin; Standard.	"	Yes.*	No tests.						*One standard trap froze.
Balt. & Ohio	1,840	870	107		B. & O.; Martin; McElroy; Safety; Standard.	Gibbs	Yes.*	Slight.	Indef.			None.	None.	*Numerous; would fill a book.
Beech Creek	132	10	10	All.	Martin	Martin	None.	None.	None.					
Cent. R. R. of N. J	652	354	103		Gold; Safety	Gold; Safety	None.*	None.	Indef.	Safety.	Gibbs	20	None.	*Not enough experience to speak with authority.
Chic & W. Mich	408	60	15		Consol.; Safety									
Cin., Ham. & Dayton	348	107	8	2	Safety	Sewall	None.	None.				126*	None.	*Baker separate heater.
Cinn., Wab. & Mich	165	22	21	6	McElroy	McElroy	None.*	Slight.				21	Indef.	*Except through cases of carelessness of trainmen in not handling properly.
Clev. & Can'on	191	34	19	6	Martin	Martin	None.	None.	Indef.			None.		
C., C., C. & St. L.	1,879	238	178		"	"	None.	Impercep.	Indef.	Martin.	Martin	125	None.	
Del., Lack. W'n	890	461	43	7	Gold	Gold; Martin	Yes.*	Yes.	Indef.			60	Indef.	*Not steam enough in cold weather.
Det., Lans. & Nor	323	55	55		Martin; Safety	Martin								
Grand Rapids & Ind	563	80	9		Martin	"								
Grand Trunk	4,100	953	18	2	Martin; Sewall	Martin; Sewall								Most cars have Baker heaters.
Ill & St. Louis	25	9	5		Timlin-Heidenger		None.	None.						
Intercolonial	894	221	8		Martin	Martin								
Lake Erie & Western	589	57	3	1	Botsford	Botsford	None.	None.	Indef.			9*		*Baker separate heater.
Lehigh Valley	1,059	240	240	All.	Martin; McElroy; Safety	McElroy	None.*	None.	Any new cars.	Martin	McElroy	None.	None.	*No extraordinary difficulty.
Louisville, Evans. & St. L.	358	38	9	1	Timlin-Heidenger	Westinghouse	None.	None.	All.	Timlin-Heidinger.	Hose	2	None.	

TABLE SHOWING PROGRESS IN HEATING PASSENGER CARS BY STEAM FROM THE LOCOMOTIVE.—(Continued.)

Louis., New Alb.& Chicago	530	54	12	.....	Martin	.....	Yes.	.....	.....	.....	Pri's Hose	68	Difficulty in regulating temperature, and with the coupling.
Mich. Cent.	1,554	281	196	.....	Martin	.....	None.	None.	.....	.....	Sewall.	None.	
New Brunswick	450	62	11	2	Consol	Sewall	None.	None.	Consol	.....	Hose	4	*None of any amount, a little difficulty with regulator at times.
N. Y., Susq. & W'n.	155	46	15	4	Consol	Martin	Slight*	6	Martin	.....	.....	1	
Pennsylvania System	7,300	120	...	...	Penn.; Erie	.....	.....	.....	.....	.....	.....	.....	
Terre Haute & Ind.	400	85	12	...	Martin	.....	.....	.....	.....	.....	.....	.....	
W'n Md.	202	60	5	...	"	.....	.....	.....	.....	.....	.....	.....	
Total	25,235	6,060	1,221	...	.....	.....	.....	.....	.....	.....	.....	435	
Western Railways.													
Bur., C. R. & Nor.	1,046	72	68	14	B., C. R. & N. Standard	.....	Slight.	None.	Rest of stock.	B., C. R. & N.	B., C. R. & N.	7	*Indef.
Chic. & Northwestern	7,156	714	37	3	C. & N. W.; Safety; Sewall	.....	Yes.*	.....	Indef.	.....	.....	136	Indef.
C., B. & Q	6,709	627	15	None.	Sewall	.....	Indef.	Indef.	Indef.	*	.....	95	All new cars.
C., M. & St. P.	5,678	382	8	.....	Martin; Safety	.....	.....	.....	.....	.....	.....	.....	
C., R. I. & Pac.	3,152	254	110	12	Sewall; Safety; Baker.	.....	None.*	Indef.†	Indef.	.....	.....	88	*Works fairly well but requires good attention. †No cold weather to test it.
C., S. Fe & Cal	500	94	94	.....	Houston	.....	None.	None.	.....	.....	.....	.....	*Train between Minneapolis and St. Paul. †Use Baker heater pipes with Gold couplings. ‡Have used it two seasons now.
Great Northern	3,395	217	3	...	Erie	.....	None.	None.	.....	.....	.....	.....	
Kan. Cy. & Ind. R. T.	8	12	All.	...	Company's	.....	None.†	None.	.....	.....	.....	.....	
Mil. & Northern	363	35	All.	...	Gibbs	.....	None.*	None.	Gibbs	.....	Gibbs	1	*Perfect success.
Mil., L. S. & W'n.	576	11	2	...	Martin	.....	None.	None.	None.	.....	.....	5	
Minn. & St. Louis	634	19	7	...	B., C. R. & N.; M. & St. L.; Sewall	.....	None.	None.	Indef.	.....	.....	7‡	*Baker and Mayson heaters.
Northern Pac.	3,725	200	2	...	Erie; Northwest'n	.....	.....	.....	.....	.....	.....	.....	
Rio Grande Western	373	30	19	...	Safety	.....	.....	.....	.....	.....	.....	.....	
St. L., Alt. & Spring.	85	12	7	...	Martin	.....	.....	.....	.....	.....	.....	.....	
Southern Pacific	5,931	1,000	...	...	Sewall	.....	.....	.....	.....	.....	.....	.....	Used on "Golden Gate special" only.
Union Pacific	6,644	278	33	...	Martin	.....	.....	.....	.....	.....	.....	.....	
Wis. Cent.	775	78	12	3	Wis. Cen.; Martin	.....	None.*	Slight.†	Indef.	.....	.....	35	*It has worked very successfully. †Nothing to speak of.
Total	46,650	4,350	491	...	.....	.....	.....	.....	.....	.....	.....	374	
Southern Railways.													
Ches. & Ohio	921	67	16	4	Sewall with Baker heater.	Sewall	Slight*	Indef.	Indef.	.....	.....	12	Indef. *Only trouble is to supply sufficient steam on the grades.
Kan. Cy., F. S. & Mem.	1,189	52	2	1	Searles	Jenks	Indef.*	.....	Indef.	.....	.....	17	*No cold weather to give through test.
Rich & Dan.	3,015	142	17	5	Martin	Martin	Yes.*	None.	Indef.	.....	.....	44	*Difficulty in regulating temperature.
Total	5,125	261	35	...	.....	.....	.....	.....	.....	.....	.....	73	
Pullman Palace Car Co.	1,950	172	...	...	Martin; McElroy; Safety.	.....	.....	.....	.....	.....	.....	.....	
Wagner Palace Car Co.	496	246	...	...	.....	.....	.....	.....	.....	.....	.....	.....	

These roads were omitted from the table as no figures of the number of cars equipped were reported to us. To the best of our knowledge, however, none of them have introduced steam car heating except on a few through express trains. Probably, therefore, the figures for the equipment of these roads would not change materially the percentage of total cars equipped.

The geographical distribution of the roads which have begun the use of steam heat is clearly shown upon our map and also in the following table:

Railways of:	All pass. trains steam heated.	Proportion of cars equipped. More than half, but less than all.	10% to 50%.	Less than 10%.	Total No. cars equipped.
New England	1,682	886	2,639	.....	1,420
New York	3,187	5,285	754	.....	3,806
Other E. of Chicago	1,679	3,649	5,684	14,223	1,221
Western	1,917	1,092	4,503	39,138	491
Southern	.....	.....	3,936	1,189	35
Palace Car Co.	.....	.....	.....	.....	418
Total	8,465	10 912	17,516	54,550	7,391

From the showing made by this table, the progress thus far can be summed up about as follows: In New York steam heat is in general use on passenger trains. By next season its use will be practically universal except on the short local roads whose passenger traffic is mostly carried in mixed trains to which steam heat is not applicable. This rapid advance in New York is due, of course, to the New York State law which forbids passenger cars (except in mixed trains) on roads over 50 miles in length to be heated by a heater inside or attached to the car.

In New England the progress made in this reform is most gratifying, and is in marked contrast to the rate of advancement of New England railways in some other important reforms in operating practice. The reason why New England railroads have been so active in this matter is still fresh in the memory of every one. The White River disaster of February, 1887, and the hair-breadth escape from a still worse holocaust at the Bussey Bridge disaster a month later, were too plain object lessons for even the conservative New Englanders to ignore, especially when backed up by legislative action, as it was in Massachusetts and Maine (although in both States the law as it at present stands is of no effect). Had these disasters occurred in the vicinity of Chicago it is all but certain that the roads of that section would be leading instead of following New England in the use of steam heat. It is a strange illustration of the small concern which people in general have for occurrences outside of their own horizon that the effect of these appalling disasters on general practice should have been so localized.

A great deal of credit for New England's progress in this matter is due to the Massachusetts Railroad Commission and its engineer, Mr. GAETANO LANZA, whose experiments, made two years ago, were of great value in furthering the reform.

Not all New England roads, however, have adopted steam heat, and some who have begun its use have done so with many protests and prophesyings of evil. Nor are those roads which still stick to the car stove entirely the poor roads in the sparsely settled districts. The rich New York, New Haven & Hartford Company, for instance, carrying an enormous passenger traffic, of which it has a practical monopoly, has devoted plenty of energy to fighting the New York steam heating law in the courts, but it has done practically nothing toward the use of steam heat, with what valid excuse for its delay we cannot conjecture.

In the division headed "Other Railways East of Chicago," it will be seen that the only railway of great prominence which has completed the introduction of steam heat is the Lehigh Valley system. Two Michigan roads, the Detroit, Lansing & Northern and the Cincinnati, Wabash & Michigan, have also completed its introduction, and deserve much credit for their progressive action.

The influence of the New York steam heating law, it will be noticed, is not confined to the limits of that State. The whole Vanderbilt system is rapidly being equipped for steam heat, and it will hardly be questioned that these roads would be no farther ahead than their neighbors had it not been for the action of the Solons at Albany. The Baltimore & Ohio and the Pennsylvania have made about equal progress, although less credit is due the former for its action, since it was undoubtedly stimulated by the Maryland steam-heating law.

Among the Western roads, as shown by the table, the work is still almost entirely experimental. The Burlington, Cedar Rapids & Northern, the Milwaukee & Northern, and the Chicago, Santa Fe & California have equipped practically all their cars, but they are the only ones. The Chicago systems, generally in the lead in improvements in operating practice which affect the safety and comfort of passengers, seem to be unaccountably backward in furthering this reform, a phase of conservatism which we will discuss farther on. Beyond St. Paul and Minneapolis nothing whatever is being done, and in fact the only trains of which we have been able to learn equipped with steam heat running west of the Missouri and southern Mississippi rivers, are the "Golden Gate Special" over the Union and Central Pacific, and possibly one or two similar through express trains on Mexican Railways.

Of course it would not be expected that the Southern roads, where heat is so much less important a factor than in the North, would take the lead in steam-heating, and the progress which the Richmond & Danville and Chesapeake & Ohio have made is very creditable. Besides these roads, we believe a steam-heated Florida express train is run over the Atlantic Coast line, Plant system of railways and Jacksonville, Tampa & Key West, although as before stated we have no official report on this point.

Canada roads seem to have done about what was

necessary to accommodate their United States connections and no more. This is probably due to the belief, which seems to be quite a general one, whether justified or not, that steam heating is not applicable to very cold climates.

PROGRESS OF DIFFERENT SYSTEMS.

The advancement which has been made in the past three years has not been effected without considerable strife. The rivalry between the different companies controlling steam heating systems has been a most active one. If any device has been defective in any point, it has not taken long for the advocates of rival devices to find out the defect and publish it, magnified enough to pay them for the trouble of hunting it up.

This sharp rivalry has had the effect of practically killing off most of the small fry, although some of them have shown a tenacity of life reminding one of the car coupler inventors who made the lives of railway men a burden a few years ago, and of which, even now, a belated specimen occasionally appears. It has also had the effect of keeping up the quality of work, and stimulating the successful companies to perfect their appliances. The result of this is seen in our table, where each of the systems in wide use is reported by its users to, on the whole, work satisfactorily. Our returns are not full enough to state the number of cars equipped by each company, which, indeed, would be an impossibility in any case, since, in a very large proportion of cases, cars are equipped with appliances from different companies, having, for instance, McElroy couplers and Martin heaters, traps, etc.

The returns indicate, however, that the Consolidated Company is a considerable distance ahead of its rivals in number of cars equipped and in number of couplers in use. As seen by the table the Sewall and McElroy couplers, both of which are controlled by the Consolidated Company, are in very extended use and have given excellent satisfaction. The second place, as regards the amount of equipment furnished, belongs to either the Martin or the Gold Company, with the chances in favor of the former. The only other companies which report a considerable amount of business are the Safety Car Heating and Lighting Co., and the Erie Car Heating Co., the former of which especially, in view of the fact that all its equipment has been put on since last fall, seems to have been quite successful.

DIFFICULTIES IN OPERATION.

Among the questions upon the blank sent out by this journal for obtaining the information from which the map and tables have been compiled was the following: "What difficulties do you find in heating cars by the system or systems in use on your lines?" Of the 48 companies which answered this question, 34 replied "none," 11 gave reports of some difficulty, and 3 referred to the difficulty as "slight." As might be expected, the commonest report is difficulty in regulating temperature. Next in frequency are leaky couplings and frozen traps. Of these 11 who report difficulties, however, none seems to be having very much trouble except the Baltimore & Ohio, which reported that a list of the difficulties met would fill a book. Inasmuch as the company has no less than 5 different systems on trial at once and has moreover only recently began its experiments, this result is scarcely a remarkable one.

Among the minor difficulties reported are warming at terminals, which still tries the souls of the Old Colony managers; pipes freezing, reported by the Manhattan Elevated and Chicago & Northwestern; drip freezing on the air-brake coupling, on the Central New England & Western, and the draft on the locomotive boiler, reported by Delaware, Lackawanna & Western and the Chesapeake & Ohio. In case of the latter road the principal draft on the boiler, however, is for steam for the electric light engine.

In regard to this once much-mooted topic, the following question was inserted in the blank: "Do you find that the draft on the locomotive for heating the cars causes an appreciable increase in its fuel consumption?"

Forty-one companies out of 53 replied "none" to this query, five replied "slight," two replied "imperceptible." The New York, Providence & Boston replied, "appreciable, but no difficulty about having steam enough." The Lake Shore & Michigan Southern reported, "appreciable where trains exceed eight cars." On the Manhattan Elevated, where trains of four or five cars are the rule, drawn, however, by very small engines compared with those used on surface roads, Mr. T. W. PEEPLES reported about 3% increase. The Long Island road reports about 6% increase. Mr. J. N. LAUDER, of the Old Colony, says: "I estimate 10% increase in very cold weather." The basis for this estimate does not appear, however, and we believe it to be quite too large.

Directly following this question was an inquiry as to whether any tests of the matter had been made. Not a single road reported any tests.

Mr. BLACKALL, of the Delaware & Hudson Canal Co.'s R. R., Northern Division, wrote us as follows:

> On our belt line trains running continuously between Albany and Troy, which are heated by steam, the locomotive will make only four round trips in summer with one tank of water. In winter when furnishing steam to heat the train they make the same number of trips with one tank of water. The increase in fuel used is not appreciable.

The statements presented, therefore, are simply those warranted by the actual observation of those in charge. It seems certain, then, that in the opinion of those best competent to judge steam heating does not cause an appreciable increase in locomotive fuel consumption. As to why this is so an explanation is offered elsewhere.

PROSPECTS FOR FURTHER EQUIPMENT.

The next question asked upon our blank was, "How many cars does your company intend to equip with steam heat before next winter, and what system and coupler will be used?" Many companies omitted to answer this, either through having their equipment completed or their plans for next season unmatured. Those who did reply, however, furnish some very conclusive evidence that uniformity of systems or uniformity of couplers even is a long way off. Those who report in about every case intend to complete their equipment with the devices at present in use, and report nothing whatever of any move toward uniformity. Of course, while uniformity of steam heating couplers is desirable, it is not the vitally essential point that it is with freight car couplers and brake couplers.

USE OF SEPARATE HEATERS.

Several questions were also placed upon our blank concerning the use of separate heaters other than the common stove; and the companies included in the table from which we received an official statement report a total of 2,139 such heaters in use. The last column of the table, however, gives the most important fact with regard to separate heaters, which is that on the roads which have begun the use of steam heat practically no more separate heaters are to be put on, except where they are to be used in conjunction with steam from the locomotive. Besides the roads given in the large table, the following returns were received from roads now using steam but having separate heaters in use:

COMPANY.	Mileage.	Cars equipped with sep. heaters.	What heaters.	No. cars to be equipped before next winter.	And with what heater.
Bridgton & Saco River	16	.....	Spear.	.....	.....
Chic. & Alton	849	All.	Baker.	.....	.....
Denver & Rio G.	1,557	252	Baker.	50	Baker.
Duluth & Iron Range	115	3	Baker.	None.	.....
Dul., So. Shore & Atl.	470	31	Baker, Mason.	Some.	.....
E. T., Va. & Ga.	1,696	35	Baker, Baker Improved.	Indefinite.	.....
Georgia	303	4	Baker, Searle.	None.	.....
Housatonic	190	45	Baker, Searle, Spear.	.....	.....
Houston & Tex. Cen.	792	47	Baker, Smith, Standard.	None.	.....
Int. & Gt. Nor.	825	2	Old Style Baker.	1	Baker.
Minn., St. P. & Sault.	796	43	Baker Fireproof.	None.	.....
Norfolk & Western	600	25	Baker.	25	.....
Ohio & Northwestern	125	8	Baker	.....	.....
Oregonian	150	3	Howard.	9	.....
Pittsburgh & Lake Erie	153	5	Baker.	5	Baker.
St. L. & S. F.	1,432	60	Baker.	.....	.....
St. L., Ark. & Tex.	1,227	4	Baker.	None.	.....
Sav., Americus & Mont.	176	12	Baker.	4 to 6	.....
Terre Haute & Peoria	176	.....	Baker.	None.	.....
Tol., Ann Arbor & N. Mich.	370	21	Baker.	Will adopt	steam heat.
Toledo, Peoria & Wis.	243	7	Baker.	None.	.....
Total	12,248	607			

It can hardly be denied, if we may judge by these returns, that the separate heater, except in conjunction with steam from the locomotive, has had its day as a means of warming cars. It was a great advance over the old stove in point of comfort and safety, and the great popular protest made at the time of the White River disaster, against that antiquated but efficient engine of destruction had the effect of greatly increasing the popularity of the hot water separate heaters. Most railway managers and mechanics were united in the belief that heating cars from the locomotive was impracticable and they were encouraged in this belief by every technical journal in this country except ENGINEERING NEWS. Wishing, however, to do something in response to the popular demand that the car stove must go, they increased their equipment of hot water heaters. At present, however, conditions are different. In the face of the wide and successful use of steam from the locomotive no one can claim that it is impracticable, and the fact is getting to be generally appreciated that adoption sooner or later is inevitable. Bearing this in mind, managers who intend to lay out money on improved heating appliances, are more likely to put it on steam heating than on separate heaters, which may have to be removed in a few years.

We had intended to present also with this issue a description of each of the several systems of car-heating which are now competing for favor, but lack of space and time obliges the delay of this matter for a few weeks. We take this opportunity to acknowledge with thanks the courtesy of the various railroad officials and car companies who have furnished us the information from which our table and map have been compiled. The extent of the progress made and the success attained in this reform will doubtless be a surprise to the many who still suppose steam car-heating to be in an experimental stage; as great a surprise as was the showing made by our map of Dec. 21, 1889, of the rapid progress made in introducing freight air-brakes and automatic couplers, which surprised everyone, even the manufacturers. It is to be hoped that the progress made in the next three years, now that the way has been marked out by the pioneers, may be sufficient to practically complete the change, and we will then ship our disused stoves and separate heaters to heat the chilly carriages of English and continental railways.

The Denver Water Co.'s Works.

According to the Denver *Republican*, the contemplated works and improvements of the Denver Water Co. will be a submerged dam, or rather caisson, built of timber. The object of this dam is to intercept the subterranean flow of water under Cherry Creek. The length of the dam will be 700 ft. Its height from bed rock to the surface of the bed of the creek will be from 60 to 70 ft., which will allow an ordinary flow of freshets to pass over its top without damming up the creek.

The plan provides for a "water gallery" 700 ft. long, 70 ft. deep and 16 ft. wide, from which the contents will be pumped into a storage reservoir located west of the creek on the Faber ranch, and which will have a capacity of upward of 50,000,000 of galls. The flow line of this reservoir is 398 ft. above datum. Altitudes elsewhere are: Above Leetsdale 318 ft., near Milo A. Smith's stand-pipe and artesian well 256 ft.

The existence of this subterranean flow has been demonstrated after a long series of careful experiments by sinking wells at different points.

The construction work is now in progress with a force of 50 men and 25 two-horse teams, which will be increased to 500 men inside of sixty days. The present steam dredge is mounted on a scow and will be used to a depth of 30 ft. after which the timber

dam will be put together and sunk, when the dredging will be done from the interior of the caisson by means of a vertical dredge, operated by an electric motor.

The work of excavation for the pumping station is now progressing. It will be 150x70 ft. and its foundations will be in bed rock. The walls will vary from 7 ft. at foundation to 2 ft. at line of water table and will require several hundred carloads of stone.

The pumping house surmounting these foundations will be a handsome stone building. Two triple expansion pumps of the most improved modern design will be the machinery used, each with a capacity of 15,000,000 galls. per day.

In general charge of the work is Captain Edward RUGER, chief engineer; W. F. HAWES, assistant engineer; Captain H. N. KING, superintendent of construction; T. A. Taylor, general foreman. It is expected that this work will require nearly a year for its completion. The estimates call for an expenditure of about $500,000.

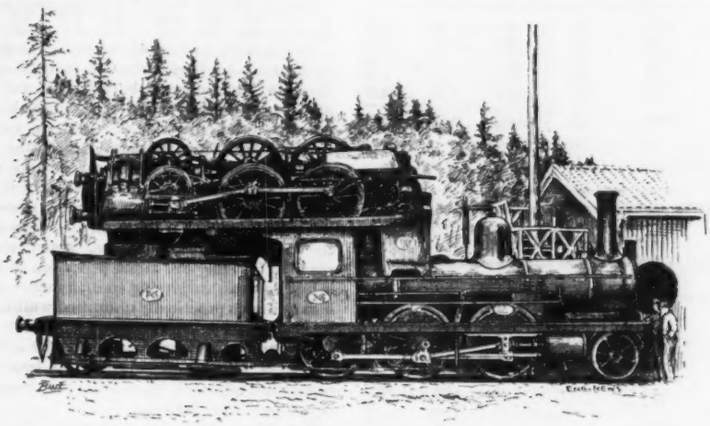


Fig. 1.—View from Right Side.

A Remarkable Boiler Explosion.

If there be in the whole list of recorded locomotive boiler explosions another one so remarkable as the one which we illustrate in the two accompanying views, it has never come to our knowledge. It occurred about two months since on the Norwegian State Railways. We are indebted for details as to the occurrence to Mr. CARL PIHL, chief engineer. The two engines shown were standing together before a freight train, taking water. As the train started to pull away the boiler of the rear engine exploded in such way that the engine was stripped from its own tender (which was uninjured) and thrown upward and forward so as to topple over, bottom side up, on the front engine, precisely as shown in our views, in which condition it was hauled down, undisturbed, to the machine shops 10 or 12 miles off, the lower engine running on its own wheels. The explosion took place at the under side of the boiler shell in front of the fire-box, and the recoil of the escaping jet was sufficiently powerful to make the engine turn a complete somersault as shown. Of five men on the two engines, one had his leg broken, the others escaped uninjured. For all that appears in the photographs of this extraordinary occurrence, from which our engravings are copied, the lower engine might have run to the shops under its own steam, the principal difficulty being obstruction of the cocks, throttle, reversing lever and fire-box door. The boiler of the lower engine was not ruptured.

In a letter transmitting these photographs and giving further information, Mr. CARL PIHL says:

In my former letter I think you have got all the necessary details, from which you will see that it really was so; that the steam did here with the engine what ARCHIMEDES thought could be done with the world if he only had a fulcrum. ARCHIMEDES' condition, however, "a piece of ground to stand on," was here provided in the shape of the hard, frozen ground beneath. The weight of the engine in working order, without the tender, was 28 tons.

The "former letter" to which Mr. PIHL refers above unfortunately failed to reach us. We were indebted for our first knowledge of this occurrence to Mr. J. W. KENDRICK, Chief Engineer of the Northern Pacific R. R. The letter may still reach us hereafter, when we can give still further details of this interesting occurrence.

No great aid can be derived from any further details, however, toward explaining this occurrence. The main facts are that the shell blew open below, close to the rear driving axle, just in front of the fire-box. No general rupture of the boiler occurred and no pieces of moment were detached. The frame was slightly sprung outward opposite the point of rupture, but no other outward evidence of where the rupture was is discoverable in any of the three photographs which lie before us. The velocity of the jet of mixed water and steam which escaped through this suddenly opened orifice was sufficient to throw over the engine by a kind of rocket-like action; for we do not see how it can have made any material difference whether there was frozen ground, or soft ground, or no ground at all for the jet to strike against. A certain bunching of the train due to the sudden loss of half the propelling power may have helped to start the engine upward, but we do not very well see how it could have helped much.

Our mathematical readers have therefore a fine chance to explain *ex post facto* how this engine was thrown up as it was. Not one of them, we are safe in predicting, would have ventured to say in advance that it was possible for a locomotive to thus disport itself, however much their figures might have seemed to indicate it; but now that it has happened, and it is certain that some sufficient cause must have operated to cause it, we have no doubt that some of them will be able to explain it mathematically. We will only hint now that an action was here present somewhat similar to that which enables the familiar injector to work. The injector is apparently a mechanical paradox, the pressure within driving in a stream of water against itself. How it does this is by communicating to the incoming *water* a velocity due to an escaping jet of *steam* at the given pressure, which enables the heavier water to easily force an entrance. We will not now attempt to follow up the parallel more closely, but leave this point to those who may attempt to explain how the apparently impossible result which we illustrate could have happened.

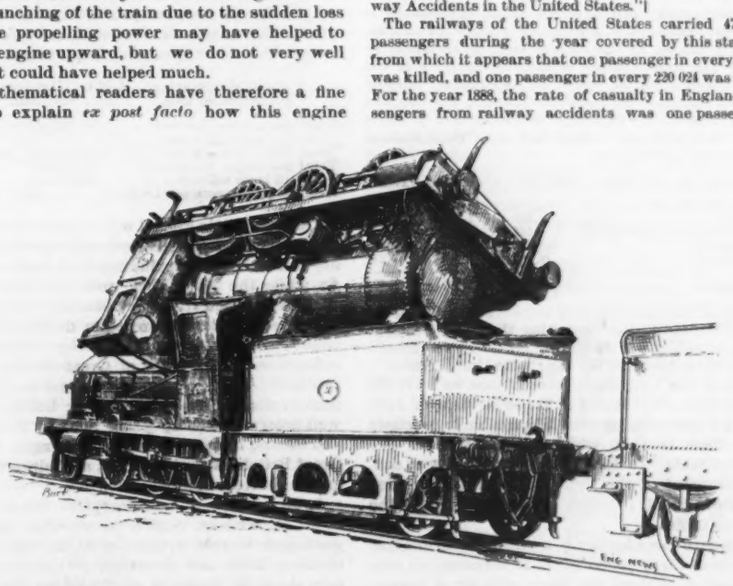


Fig. 2.—View from Left Side—A Remarkable Boiler Explosion, Norwegian State Railways.

Railway Accident Statistics of the United States and Great Britain.

For the first time in the history of the United States a reasonably complete and accurate classified record of *all* railway accidents and accidents on railways has appeared. It shows, as was to be expected, about two and a half times as many train accident casualties only as has heretofore appeared in the only available record, the confessedly imperfect one kept by the *Railroad Gazette*, while it gives also *all* deaths resulting from the operation of railways, from whatever cause, amounting in the aggregate to about *five times* as many deaths and injuries as occur from train accidents only, and to about *twelve times* as many deaths and injuries as have been heretofore caught in the unofficial record referred to.

The accident record for the United Kingdom for the calendar year 1889 has also recently come to hand, and the two together enable us to make the really fair and accurate comparison of the actual comparative casualties on English and American railways. As such, the record following has an exceptional interest.

The railway accident statistics for the United States are for the year ending June 30, 1889. They were compiled in the office of the Statistician to the Interstate Commerce Commission, and have just been presented to the National Convention of Railroad Commissioners, convened in Washington, May 28, 1890. The record as presented is in full as follows:

The figures given below makes an exhibit of the number killed and injured under the three heads, "Employees,' "Passengers," and "Other Persons." The further show the classes of accidents, and the loss of life and injury to persons resulting from each. A summary of these facts is given in the table which follows: [headed "Railway Accidents in the United States."]

The railways of the United States carried 472,171,343 passengers during the year covered by this statement, from which it appears that one passenger in every 1,523,133 was killed, and one passenger in every 220 024 was injured. For the year 1888, the rate of casualty in England to passengers from railway accidents was one passenger in 6,942,336 killed, and one passenger in 527,577 injured. In judging of the above figures, it should be noted that passenger mileage for a given number of tickets sold is much greater in the United States than in England, a fact which mitigates somewhat [very much, as will be seen below.—ED.] the severity of judgment upon railway management in the United States disclosed in the above comparison.

[The average miles travelled by each passenger in England is only 8 miles; in the United States, 26 miles. Therefore, on the basis of *passenger miles* instead of mere number of passengers, we have from these figures the following comparison:

	Passenger miles per passenger. Killed.	Injured.
In the United States.....	39,601,456	5,720,624
In Great Britian.....	55,538,668	4,220,616

It, therefore, appears that on this, the only fair

basis, the difference in favor of Great Britain is only nominal. Such difference as exists is readily explained by difference of conditions, which, in fact would explain a considerably greater difference than exists.—ED.]

the following comparative operating records in the computations below. As the operating records for the year 1889 are not yet at hand for either country we have preferred to estimate them by making a slight increase from the records of previous years,

RAILWAY ACCIDENTS IN THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1889.

KIND OF ACCIDENT.	Employés.		Passengers.		Other Persons.		Total.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Coupling cars	300	6,757	.....	.....	.....	.....	300	6,757
Falling from trains	493	2,011	.....	.....	.....	.....	493	2,011
Overhead obstructions	65	296	.....	.....	.....	.....	65	296
Collisions	167	820	107	445	37	48	311	1,313
Derailments	125	655	28	389	29	69	182	1,113
Other train accidents	189	1,016	26	247	522	515	737	1,778
At highway crossings	24	45	3	16	410	634	437	695
At stations	70	699	26	295	328	472	424	1,466
Other causes	539	7,729	120	754	2,215	2,397	2,874	10,880
Total	1,972	20,028	310	2,146	3,541	4,135	5,823	26,309
Ratio killed to injured	1 to 10.2		1 to 6.9		1 to 1.2		1 to 4.5	

NOTE.—We add to this table the last line, "Ratio killed to injured," for a purpose explained in the text.

RAILWAY ACCIDENTS IN GREAT BRITAIN FOR THE YEAR ENDING DEC. 31, 1889.

☞ *Omitting* the terrible Armagh, Ireland, accident, June 12, 1890, with 78 deaths and 260 injuries of passengers.

KIND OF ACCIDENT.	Employés.		Passengers.		Other Persons.		Total.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Coupling cars	127	1,521	.....	.....	.....	.....	127	1,521
Falling from trains	51	426	16	34	.....	.....	67	460
Overhead obstructions	13	30	.....	.....	.....	.....	13	30
Collisions	3	87	8	322	.....	.....	11	409
Derailments	.....	11	1	231	.....	.....	1	242
Other train accidents	1	19	1	203	.....	.....	2	222
At highway crossings	3	1	.....	.....	72	42	75	43
At stations	.....	.....	59	575	.....	.....	59	575
Other causes	237	674	20	204	386	196	643	1,074
Total	435	2,769	105	1,569	458	238	908	4,576
Ratio killed to injured	1 to 6.4		1 to 15.0		1 to 0.5		1 to 4.6	

The Armagh collision, 78 passengers killed and 260 injured, *omitted*, as a very exceptional occurrence, in order to give a fairer comparison. The totals, consequently, are by that amount *less than the official totals.*

In order to appreciate the above exhibit of casualties to employés of railways, it is necessary to know the number of employés liable to the various sorts of accidents recorded. The total number of railway employés in the United States is 704,736, which for the present purpose may be divided into trainmen; switchmen, flagmen, and watchmen; and other employés. The number of employés in each class, as also the casualties to each class, is given in the following statement :

CASUALTIES TO EMPLOYES ASSIGNED TO CLASSES NAMED.

Class of employés.	Number.	Killed.	Injured.
Trainmen	137,334	1,179	11,301
Switch, flag and watchmen	33,344	229	2,155
Other employés	517,820	536	6,380
Unclassified	16,238	28	214
Total	704,736	1,972	20,030

The above facts are presented without comment respecting their significance, or respecting their bearing upon the general question of legislation providing for greater safety in the operation of railways in the United States.

To effect our purpose of comparison we have abstracted from the "Board of Trade Returns of Accidents" for the calendar year 1890, a table in precisely similar form to this, which we print below the American table. To do this it was necessary to consolidate several of the British items into one, they being subdivided in much more detail than the American table.

To compare these accident records, or to analyze either one of them properly, it is necessary to consider much more than the mere number of passengers carried, or even the number of passenger miles. Both passenger train mileage and total train mileage are also important units of comparison, although comparatively little used. For it is apparent that many classes of accidents to persons, if not all classes, are likely to vary largely with the number of passenger *trains*, and it is also apparent that the accidents to passenger trains, and to persons on and about them, are likely to be very largely affected by the *total* number of trains running over the line, while a large proportion of the accidents to persons other than passengers are caused directly by freight trains. It would be obviously unfair to forget, for example, that in the United States there are 1.45 freight trains running for every passenger train, and in Great Britain only 0.90 freight trains.

We have therefore made more or less use of all rather than to use more precise figures for a prior year. The error is thus reduced, and what remains is too slight to be of sensible importance:

Estimated Operating Statistics for 1889.	United Kingdom Cal. Year 1889.	U. S. Year Ending June 30, 1889.
Total passengers carried	750,000,000	472,171,343
Average miles hauled	8	26
Total passenger-miles	6,000,000,000	12,276,454,000
Total passenger train-miles	150,000,000	300,000,000
Total all train mileage	285,000,000	732,000,000
Average passengers per train.	40	41

From this little table it will be seen that, although the number of passengers is much larger in Great Britain (their statistics including the London local traffic, while the New York and Brooklyn Elevated traffic is omitted from our returns), yet the number of *passenger-miles* is more than double what it is in Great Britain. Accurate statistics of the passenger mileage or ton-mileage of Great Britain are not available, owing to an unfortunate defect in the statistics collected in that country; but it was pretty well determined some years ago, by E. B. DORSEY and others, that the average passenger journey in Great Britain is about 8 miles, and since then it has grown shorter rather than longer.

As an evidence of how deceptive a mere count of noses is, without regard to whether an average passenger travels 8 miles or 80, the daily traffic of the New York and Brooklyn elevated railways is now about 700,000 daily, or 255,500,000 per year; so that we should at once add 54 per cent. to the "number of passengers" in the United States by including them, as the corresponding traffic is included in England; and this without adding any thing appreciable to the total of accidents, such traffic being run at slow speeds and otherwise under peculiarly favorable conditions.

These preliminaries out of the way, we proceed to compare the records.

The first question which arises is as to the comparative fidelity and completeness of the returns, and it is now universally understood that one of the best tests of this is the *ratio* of reported injuries to reported deaths. When there is slackness in returns, it is particularly apt to show in the total of injuries, only the very severe ones being reported. We have, therefore, added a line for this ratio below each of the main tables, and it will be seen that our American returns compare most favorably with the British, which are known to be very accurate and complete.

Of the definite figures, let us first consider the grand totals of all casualties, since there are certain differences of clasification which seriously affect comparison of the separate items. This record stands as follows:

Total of all Railway Casualties.

	Employés.		Passengers.		Others.		Total.	
	Kill'd	Inj.	Kill'd	Inj.	Kill'd	Inj.	Kill'd	Inj.
U. S.	1,972	20,028	310	2,146	3,541	4,135	5,823	26,309
Brit.	435	2,769	105	1,569	458	328	908	4,576
Do. per Million Train Miles (both pass. and freight).								
U. S.	2.7	27.4	0.42	2.9	4.8	5.6	7.9	35.9
Brit.	1.5	9.7	0.37	5.5	1.6	0.8	3.5	16.0

The fairest and most accurate single basis of comparison for these totals of casualties is plainly the total train mileage, both freight and passenger, since large classes of these injuries, including all except the injuries to passengers, are more affected by the freight train mileage than by the passenger, while passenger casualties are largely affected by freight trains. The total casualties per million train miles will be seen to be considerably more here than in Great Britain, but after all, all things considered, the record is a fairly good one. Many more trespassers and "others" are killed here than in England, as is but natural, we having so many more grade crossings and such practically unlimited walking on track, which in Europe is everywhere strictly forbidden. The same cause largely accounts for our excess of employés killed and injured. In total passenger casualties per total train mile our record is even better than the English.

The fairer basis for comparing the passenger casualties, however, is undoubtedly the passenger train-mileage, or passenger-mileage, which latter gives practically the same result, the average passenger train load being nearly identical in the two countries. On this basis, we have :

Passenger Casualties per Million Passenger Train Miles.

	Killed.	Injured.
United States	1.04	7.2
Great Britain	0.70	10.4

Here also we compare well; yet, if we should use the customary British unit of comparison, *number* of passengers we should compare very ill, our proportion of casualties being apparently multiplied three-fold. This results from the fact that while the average train load is practically the same in both countries, the individuals who make it up change every 8 miles in England against every 26 miles here. Of course, there is a certain additional risk in these more frequent changes, but on the whole, a man riding 26 miles has about three times the chance of injury of one riding only 8, under otherwise equal conditions.

When we come to train accidents only, however, including collisions, derailments and "other," we compare most unfavorably with Great Britain "on the face of the returns," especially in number of killed, as follows, it being always remembered that we have left out 78 deaths and 260 injuries due to the Armagh disaster,, as exceptional:

Casualties from train accidents only :

	Employés		Passengers		Others		Total	
	Killed.	Inj.	Killed.	Inj.	Killed.	Inj.	Killed.	Inj.
U. S.	481	2,491	161	1,081	588	632	1,230	4,204
Brit	4	117	10	756	...	...	14	873
do. per million train miles (both pass. and freight).								
U. S.	0.65	3.40	0.22	1.48	0.81	0.86	1.68	5.74
Brit.	0.01	0.41	0.01	2.65	....	....	0.05	3.06

The contrast here is so great that it is impossible not to believe that there is some great difference in classification, the American returns including many accidents *from* trains as well as *to* trains. The British accidents seem to be properly classified; and the American clearly improperly in this respect, at least; that in any real train accident it is rare that any one is either killed or injured unless a passenger or employé, while the U. S, returns show nearly half the deaths from them to be of "others." It will be well for the statistician of the Interstate Commerce Commission to investigate this matter, and be sure that he is classifying the returns correctly.

Moreover, by omitting the Armagh accident, we have made the showing much too favorable for the British lines in deaths of passengers. Their yearly average for some years past, as reviewed in detail in our issue of Sept. 21, 1889, has been :

	Killed.	Injured.
1874 to 1878	35.2	1,188
1879 to 1883	31.2	792
1884 to 1888	16.2	609
1889 less Armagh	10.	756

Counting in the Armagh accident, an average of

the past ten years would be 33 persons killed, and this is really the fairer total to take, instead of 10. The effect of this change can be readily determined above.

In accidents from coupling cars honors are more nearly easy. The totals of these for the two countries, and the totals per million of freight train miles, stand as follows:

	Employees. killed.	injured.	Per million frt. train miles. killed.	injured.
U. S.	300	6,757	0.70	15.6
Brit.	127	1,521	0.94	11.3

Considering that our freight trains are nearly twice as heavy as the British, this is a creditable showing. The British loss is worse in proportion than ours; and it is not without significance that, whereas our loss has caused a persistent agitation for many years past, which has already borne fruit in a well advanced change of practice, the British loss is accepted as one of the inevitable things, and a change is not even seriously discussed.

In "falling from trains" the record is without special significance. The proportion is about what might be expected from the differing conditions and traffic of the two countries.

In accidents "at stations" there is evidently a difference of classifications which forbids intelligent comparison. The British reports cover passengers only; the American, passengers, employés and "others."

In accidents at "highway crossings" we are far in the lead, but not nearly so much so as one might expect from the great number of highway grade crossings in this country and the very small number in England. The totals stand:

	Highway crossing accidents. Killed.	Injured.
U. S.	437	695
British	67	160

We suspect that a good part of our so-called "train-accident" casualties really belong in here. Our totals do not seem to be large enough, either absolutely or relatively; for we regard it as quite certain that much more than 500 (1½ per day) persons are yearly killed at the grade crossings of the United States, taken all together.

We have no space left to do more than call attention to the frightful proportion of injuries to men employed among our trainmen and yard employés, at least two-thirds of which would be saved if automatic train brakes and couplers were to-day in universal use.

Ocean Racers and Icebergs.

Some years ago the editor of this journal chanced to be crossing on the *Germanic*, when an iceberg suddenly loomed in sight, the general outlines of which (apart from its size in comparison with the

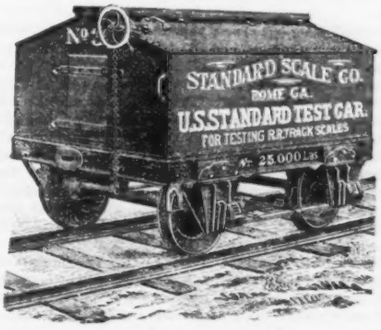
ship) are faithfully reproduced in the accompanying sketch. As the light grew dimmer, by a curious paradox, it became possible to fill in more detail, until the sketch ended by taking the form here shown.

This week, the new ocean clipper *Normannia* has, for the tenth or eleventh time since that date, had a narrow escape from sending a thousand or two souls very suddenly to their account, by collision with another such iceberg; and certainly it was one of the narrowest escapes on record. After passing an almost unbroken procession of icebergs all day long, 22 in all, night and fog settled down together. "Capt. HERICH did not suspect any danger lurking behind the gray wall." Oh, no! Or if he did, he kept his council, determined to "get there, all the same." He kept bounding along at 17 knots an hour, intent on record-breaking, and he actually did break the record of maiden voyages by at least five hours, deducting the time lost by toying with the iceberg which he encountered but a very few minutes after he entered the fog. The details of his encounter, and almost miraculous escape are already familiar to most of our readers. We will not rehearse them.

Some of these days some one of these record breakers will break a record that he does not wish to break; and then, too late, a howl will go up over the whole civilized world at the criminal folly of driving steamers at full speed through dense fogs and waters filled with icebergs; and of taking routes which unnecessarily run through these fields of icebergs, merely to save a few miles of distance. The time to raise the howl is now, and not after the event. It has occurred to us that a useful purpose might be subserved by reproducing an idle sketch which, however much it may exaggerate the actual size of an iceberg, does not at all exaggerate the nature of the danger which is now daily braved with foolhardy and criminal, because needless, recklessness.

A Standard Scale-Testing Car.

We find in the *Manufacturers' Record*, of Baltimore, Tenn., the accompanying rather rude cut of a device which seems to us worth imitating, viz.: a scale testing car designed to be run over the road



A Standard Scale Testing Car.

for testing scales up to heavy loads, instead of relying on the usual small standard castings which are sent around from point to point and only afford a small range for testing.

The car illustrated is one of the test cars used by the Standard Scale Co., of Rome, Ga., for testing railroad track scales. The cars are built entirely of iron and weigh 12,500 lbs. Inside the car is carried 12,500 lbs. of U. S. standard test weights. Once a month, or for every 1,000 miles the car travels, it is compared with the weights, and any loss occasioned by wear of wheels or brake shoes is made up, and a total test of 25,000 lbs. is secured. The car, being short this weight, can be concentrated over each section of the scale (which are tested and adjusted separately), and is thus equal to a test of 100,000 lbs., on the ordinary length railroad scale. These cars, we learn, are run over nearly all the railroads in the South, and the company who operate them make no charge for testing their own make of scales when the car is at hand. We understand this new departure in testing scales is highly appreciated.

The Elyria Arch—Correction.

In our description of the beautiful stone arch at Elyria, O., published May 29, an important error occurred in computing the radius, as noted in a letter in another column. It should have been given as 117⅝ ft. instead of 208¼ ft. The error was our own and not the designer's. It brings the key into close correspondence with both RANKINE's and TRAUTWINE's rules, instead of totally different.

PERSONALS.

Mr. H. K. ENOS has been elected President of the Missouri, Kansas & Texas Ry.

Mr. ROBERT HAY, Superintendent of the Eastern and Champlain districts of the Grand Trunk Ry., has resigned his position.

Mr. JAMES W. SHANKS, Superintendent of the Maddox & Hobart distilleries, at Dayton, Ky., is to assume the position of Superintendent of the Newport and Addystone Pipe Works.

Prof. GEORGE W. SHERWOOD, Instructor in Civil Engineering at Lehigh University, has resigned, and gone to Nicaragua. He has accepted the position of Engineer of Construction on the Nicaragua Canal.

Mr. CHARLES WHITING BAKER, Associate Editor of ENGINEERING NEWS, was married at Burlington, Vt., on Wednesday, June 4, to Miss REBEKAH WHEELER, daughter of Mrs. MARY HOCKLEY WHEELER, of that city.

Mr. F. C. FINKLE, C. E., has been appointed Chief Engineer of the city water-works of San Bernardino, Cal.; he is also engineer of the electric light plant of that city. Over $500,000 is to be expended there within the next year in building water-works and electric lighting plants.

Mr. THOMAS LOWRY, it is stated, will resign from the presidency of the Minneapolis, St. Paul & Sault Ste. Marie R. R., and will hereafter devote his time to his interests in street railways. F. N. FINNEY, formerly General Manager of the Wisconsin Central R. R., will, it is stated, succeed him.

Mr. GEORGE B. HARRIS has been elected second vice-president of this company, in place of Mr. HENRY B. STONE, resigned. For the present, and until further orders, Mr. HARRIS will also take upon himself the duties of general manager of the lines in Illinois and Iowa, in place of Mr. E. P. RIPLEY, resigned.

Mr. J. F. GODDARD, who has resigned the second vice-presidency of the Atchison, Topeka & Santa Fe R. R., has received the offer of the chairmanship of the Trunk Line Passenger Association, a place which has been vacant since the resignation of LUCIUS TUTTLE. Mr. GODDARD has not yet decided whether or not to accept the offer.

Major J. C. PAUL, late General Manager of the Woodruff Sleeping Car Co. and Superintendent of Equipment of Pullman Car Co., has been appointed Vice-President of the American Steel Car Wheel Co., of Boston, and will have the general charge of the Sales Department, with his office at 115 Broadway, New York.

Mr. S. N. KEITH, spoken of as a well known civil engineer of Seattle, has been committed to an insane asylum there. He was formerly connected with the Seattle, Lake Shore & Eastern R. R., and is reported as having, several years ago, spent some thousands of dollars in locating a line to "a low pass" in the Cascades, which afterwards turned out to be only a clearing on top of the ridge.

Prof. HORACE BEACH, of Wisconsin, accompanied by Maj. F. F. B. COFFIN, State Engineer of Irrigation, has left for Aberdeen, Webster, Millbank, and points in North Dakota. Prof. BEACH is a special detail to assist in the artesian wells and irrigation investigation. He will give special attention to locating water veins and pointing out places where artesian wells can be sunk with assurances of success.

Mr. W. A. DOANE, Principal Assistant Engineer, Ohio Extension, Norfolk & Western R. R., writes to say that in our article on the Ceredo bridge, in our issue of May 17, we credited him with the office of Chief Engineer. Mr. W. W. COE is Chief Engineer of the Norfolk & Western, and also of the Ohio Extension, Mr. DOANE holding the position first named above. Mr. WM. D. JANNEY is Division Engineer in direct charge of the division including the bridge.

Mr. F. L. SHEPHERD, recently appointed Superintendent of the Pennsylvania R. R. Division, has had his appointment confirmed by the directors of the company. Mr. SHEPHERD entered the service of the company as an apprentice in the Altoona shops in 1868, and has been since continuously in the service in different capacities. From 1881 to 1882 he acted as Superintendent of the Sunbury Division of the Philadelphia & Erie Railroad Division, and since 18.2 has been Superintendent of Motive Power of the Pennsylvania Railroad Division.

Mr. FRANCIS C. LOWTHORP, Fellow of the American Society of Civil Engineers, died on June 1 at his residence in Trenton, N. J. Mr. Lowthorp was one of the early makers of iron bridges, and in June, 1857, he patented a truss with cast-iron posts and top-chord, with a tension, or "straining rod," in the latter. The bottom chord was made of continuous plates pinned to the bottom of each post. The truss was one of the double-cancellation type with vertical posts. The high bridge over the Jo-

dan Creek, near Allentown, Pa., built by Mr. Lowthorp, was one of the first iron railway bridges in this country.

Mr. W. H. HALL, Supervising Engineer of the Arid Land Survey for the Western grand division, has started on a month's tour of Oregon, Washington, Idaho and other sections of the West, to look after the gauging of streams. This hydrographic work constitutes the only operations of the survey at present. Mr. HALL will put in operation at several places the electric report current meter used by the cable and traveler method, which is a recent invention of his own, and which is said to gauge the flow of streams with much greater facility and precision than the old method and with a fraction of the expense.

Mr. BRAINERD SPOONER, the inventor of the Spooner Water Meter, died suddenly at Boston, Mass., on Sunday. Mr. SPOONER was born in Belchertown, Mass., in November, 1820. In early life he was at the Springfield Armory, and then established himself in the photographic business in that city, being the first man in the State outside of Boston to become a professional photographer. In 1850 he removed to Syracuse, N. Y. It was in 1850 he conceived the idea of a water meter, and in 1870 he completed it. In 1880 he came to Boston, and sought to have his invention adopted here, but without success. Mr. SPOONER also invented the letemeter.

Major OTHO E. MICHAELIS, U. S. A., whose unexpected death was recently referred to in this journal, was at one time a prominent member of the Franklin Institute, in Philadelphia. The *Journal* of the Institute in a memoir of Major MICHAELIS, states that he was born in Germany, and came to this country at an early age. He entered the U. S. Signal Service as Second Lieutenant, Sept. 30, 1863; was appointed a Second Lieutenant of the Ordnance Corps, Nov. 24, 1863; First Lieutenant, Sept. 12 1864; Captain, Jan. 23, 1874, and Major shortly before his death. In conclusion, this memoir happily pictures the man, as his friends knew him, as follows:

"This brief record of his services, taken from the Army Register, gives no idea of the man. With a naturally acute and observant mind he united a philosophical faculty which is rare even among those who devote themselves to the mathematical sciences. It was his delight to attack problems both in and out of his profession, and to solve them—which he usually did. Many of the improvements in the machines and in the Ordnance Department, and some important modifications of the famous testing machine in the Watervliet Arsenal are due to his intelligence and sharp observation. It is doubtful if there was another officer in the army more thoroughly equipped with a mind to take advantage of, and a diligence to secure a complete record of all that is transpiring around him in the field of research. He neglected no opportunity of learning, and shirked no labor in elaborating the details of all that bore on this favorite arm of the service. His loss to the Ordnance Department is one difficult to supply.

"Major Michaelis was an excellent conversationalist in any gathering, full of anecdote, possessing an imperturbable good humor and the tact to make himself popular. He was fond of all manly sports, and an adept at chess and whist; in fact, he had a national reputation at the first of these games, and even in his early "teens" he contested two games manfully with the great Paul Morphy, taking the odds of a rook, which were thought worthy of a place in the commemorative volume of Lange, in which most of the master's games which have been preserved are published. Later, in 1883, he played a noteworthy game with the greatest of modern masters, Steinitz, which resulted in a draw."

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—Record of regular meeting, May 17, 1890. President H. W. Spangler in the chair; 35 members and two visitors present. Prof. J. W. Redway read a paper on the Physical Geography of the Mississippi River. The Secretary presented, for Mr. Geo. W. Creighton, a paper on Rail Joints.

HOWARD MURPHY, *Secretary and Treasurer.*

Master Mechanics' Association.—Secretary ANGUS SINCLAIR announces that members of the Master Car Builders' and Master Mechanics' Associations who require transportation over the Chesapeake & Ohio Railroad in going to or returning from the conventions at Old Point Comfort, may obtain it from Mr. WM. GARSTANG, Supt. M. P., Richmond, Va. President INGALLS, of the Chesapeake & Ohio, has consented to deliver the address of welcome at the opening of the convention.

The Engineering Association of the Southwest will hold its next meeting at Nashville, Tenn., June 12. The programme of the evening will include the following papers: "Coke Making in the Western Kentucky Coal Field," by Mr. John B. Atkinson, of Earlington, Ky. "The Foundations of the Georgia Pacific R. R Bridge over the Yazoo river, Miss., by Mr. A. V. Gude, of Atlanta, Ga. "The Measurement of the Discharge of the Tennessee and Cumberland rivers," by Mr. C. A. Turrell, Nashville, Tenn.

OLIN H. LANDRETH, Secretary.

The Denver Society of Civil Engineers.—Meeting of May 28, Mr. George G. Anderson presiding. The paper of the evening was on "Forms and Construction of Dams and Reservoirs," by Mr. W. W. Follett. The speaker commenced by pointing out what were the undesirable sites for reservoir purposes, and illustrated his point by describing various failures in dam construction due to founding on gravel, or in a débris-filled arroyo, or in making the reservoir too shallow. Mr. Follett, speaking of evaporation, said that at El Paso the evaporation pan last summer showed as high as 10 ins. per month. The chief trouble in locating and designing reservoirs, said Mr. Follett, is to be found in the opposition to appropriating land under cultivation; though this may ultimately be the best policy, and in the smallness of the promoter's ideas. Many men stand aghast at a plan for a 100-ft. dam, though this may be the only true solution of the problem. The engineer's only limit in expense should be a certain amount per acre to be irrigated; this may amount to $5 per acre in high altitudes and medium soil, or $25 to $30 per acre in a fruit country. Considerable discussion followed the paper. Mr. Stanton was invited to read a paper on the possibility of a railroad route through the Grand Cañon of the Colorado.

American Society of Civil Engineers.—*Annual Convention of* 1890—The convention will be held at Cresson, Pa., beginning Thursday, June 26. The rate at the large and excellent hotel has been reduced to $3 per day. The President of the Society, William P. Shinn, Esq., will deliver the annual address. A rate of fare of one and one-third full fare is offered.

A special train will leave New York, foot of Cortlandt or Desbrosses Sts., on Wednesday morning, June 25, at 10 A. M., and run as a second section of the Chicago Limited, arriving at Cresson in the afternoon. This train will be made up of chartered cars, and the cost to each person will be about that of the ordinary Pullman accommodation.

The following (nine) new papers will be presented at the convention: "On a method of taking cross-sections of deep rock cuts by triangulation," F. W. Watkins; "On the Littoral Movements of Inlets along the Coast of New Jersey," Lewis M. Haupt; "The Designing and Erection of the Oakley Arch," J. Foster Crowell; "The Stability of Loaded Masonry Arches," A. S. C. Wurtele; "Irrigation in India," Herbert M. Wilson; "Construction and Maintenance of Track," Julien A. Hall; "Street Electric Railways," O. H. Landreth; "The Ventilation of Tunnels," N. W. Eayrs; "Inland Sewage Disposal, with special reference to the East Orange (N. J.) Works," Carrol Ph. Bassett.

The Board of Directors invites further papers and communications. It is expected that reports will be presented by the special committees on revision of the constitution, uniform standard time, compressive strength of cements and the compression of mortars and settlement of masonry, uniform methods of testing materials, and standard rail sections.

A meeting of the committee on standard rail sections will be held at the hotel headquarters on the evening of June 25. A full attendance is requested.

JOHN BOGART, Secy.

Engineers' Club of Kansas City.—Meeting of May 12, 1890, F. E. Sickles in the chair, K. Allen, Secretary. There were present eleven members. Mr. A. J. Mason read, for the Committee on Affiliation of Engineering Societies, abstracts from a communication from Prof. J. B. Johnson, of St. Louis, proposing a federation of the leading engineering Societies (including the "Association"). Mr. Mason also presented a brief verbal report for the Committee on Affiliation, the sentiment of which was adverse to a connection of the local societies with the American Society. On motion of K. Allen, the report was accepted and the committee requested to continue. The Secretary read for the author, Robert M. Sheridan, a paper on "The Evolution of the Elevator." Beginning with the year 1855, the paper traced the growth of the elevator engine from the oscillating cylinder reversing engines (which marked the first step in the development of this branch of engineering) to the perfected steam worm geared passenger elevator engine in use at the present time. A summary of the various steps embracing the changes in engines of this class was presented. The vertical cylinder hydraulic machine was described and contrasted with the perfected horizontal cylinder elevator and its improvements. The workings and advantages of the lever operating device in its connection with the auxiliary valve, together with the pronounced usefulness of the independent automatic stop valve, were explained. The description of the principle of the centrifugal governor attached to the car as a safety device for arresting the car's motion was given and accompanied by a general statement concerning the present requisites for elevator service, covering the point of absolute regulation at the highest speeds by the use of the improvements mentioned. The travel of the tower elevator in the Chicago Auditorium building, passing through a distance of 220 ft. at a speed of about seven miles per hour, or 600 ft. per minute, was cited as a case in point covering the various demands upon elevator service at the present time. The future of the work, judging by the past, insures the elevator's evolution along the lines now set, keeping pace with the demand for buildings that tower nearer the sky year by year.

KENNETH ALLEN, *Secretary.*

Iron and Steel Institute.—At the invitation of the American Institute of Mining Engineers, cordially supported by the American Iron and Steel Association, the American Society of Civil Engineers, the American Society of Mechanical Engineers and the United States Association of Charcoal Iron Workers, the Iron and Steel Institute of Great Britain has decided to hold its fall meeting in the United States. An invitation has also been extended to the *Verein Deutscher Eisenhüttenleute*. Some 400 visitors, not including ladies, are likely to cross the water. A committee has been formed in this country.

The foreign guests will arrive here, in different steamers, toward the close of September. Many of them will attend the New York meeting of the American Institute of Mining Engineers on Sept. 29-30, the officers of that society being Hon. ABRAM S. HEWITT, president, and Dr. R. W. RAYMOND, Secretary. The first technical session of the Iron and Steel Institute and the formal reception of the visitors will be held on Wednesday, Oct. 1. During the stay in New York the statue of ALEXANDER L. HOLLEY will be unveiled.

At Pittsburg two International sessions will be held, the details thereof being in charge of Dr. R. W. RAYMOND. A list of technical papers by the most distinguished American and foreign engineers is now being prepared. The dates for the meeting and programme of trips is as follows:

New York meeting of the American Institute of Mining Engineers, to which foreigner guests are invited, Sept. 29, 30.

Meeting of the Iron and Steel Institute, Oct. 1-3; Philadelphia, Oct. 4-6; Lebanon and Harrisburg, Oct. 7; Johnstown and Altoona, Thursday, Oct. 9; Pittsburg, including two International sessions, Oct. 9-12; Chicago, Oct. 13-14.

At Chicago the party will divide into two groups; one, the Northern (I), going to Lake Superior, and the other to the South (II).

Northern trip, Oct. 15-25.—Chapin Mine and plant, Gogebic Iron Range, Lake Superior Copper Mines from Houghton, Mines of Marquette Range, Sault Ste. Marie Canal and locks, Niagara Falls to New York. Those of this party who desire will be conveyed to Washington and return, Oct. 14-27.

Southern Trip—Birmingham, Shelby and Anniston, Ala., Lookout Mountain, Chattanooga, Middlesborough, Ky., Knoxville, Tenn., The Pocahontas Coal Field, Roanoke, Va., Luray Cave, Washington, New York.

Those of this party who so desire will be conveyed to Niagara Falls, returning to New York, Wednesday, Oct. 29.

The officers of the American Reception Committee are: Andrew Carnegie, Chairman, 5 West 51st street, New York; George A. Crocker, Treasurer, 32 Cliff street, New York; C. Kirchhoff, Jr., Secretary, 66 Duane street, New York.

Engineering Association of the Southwest. Report of Executive Committee on the Circular Letter on Affiliation received from the American Society of Civil Engineers.

The committee note that an analysis of the functions of engineering organizations will show that they are divisible into three quite distinct classes:

(1) Those of a purely general nature. (2) Those of a purely special character, limited to some one or more subdivision of the profession, but not by locality. (3) Those that are largely local.

We are of opinion that the two first of the above three functions can be provided for by one national organization which shall possess a dual character: first, that of a single homogeneous organization to be assumed when acting on questions falling under the first class, and second, that of a federation of distinct special organizations, each one of which would properly deal with questions of the second class. A true parallel to the proposed form of organization now exists in the American Association for the Advancement of Science.

We suggest to the American Society of Civil Engineers the advisability of considering whether or not the above proposed federation may not be brought about by an affiliation between that body and the other present existing national organizations—namely, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Institute of Architects, the American Institute of Electrical Engineers—into one federation in which each originally distinct organization shall retain, in the main, its distinctive character and distinct government, modifying only such of the present features as should be found necessary to insure that uniformity and symmetry needed for successful co-operation.

Such a federation, with the functions and scope of the general body and of its several subdivisions established; with its qualifications for membership so high as to be a guarantee of professional ability, and still so adjusted as to preserve its representative character; with its several sections occupying the same building, building

up a library in common, issuing in common a journal containing the transactions of its several sections, would, we believe, be in a position to handle with authority, with dignity and with promptness all matters which fall in the two first classes above mentioned, and would do so with greater thoroughness and efficiency than is possible under the present isolated condition of the several national societies. As to the name of the above proposed federation, while a matter of secondary importance, we believe that, as a separation in the near future of the military from the purely civilian engineering work of the government is likely to be accomplished, we see no reason why the term Civil Engineer should not be restored to its original meaning as a *general* term, including the branches of mechanical, mining, electrical, hydraulic, railroad and sanitary engineering—in fact, covering all branches of engineering of a civil nature, and being therefore distinguished only from naval and military engineering. Following this idea, we see no reason why the term American Association of Civil Engineers might not properly be applied to the above federation of engineering societies.

Regarding the third class of functions, those largely local in their character, we are of the opinion that it is extremely desirable that these functions be provided for by purely local organization, *wholly independent* in their government, managing their own financial affairs, holding their own property, and establishing their own qualifications as to membership. We believe, however, that a certain affiliation and co-operation between such organizations is wholly feasible and desirable. Such affiliation, we think, however, should be limited to features of the following general nature: Provisions for transmitting to the national organization all matters, questions and papers which fall properly within the first two of the above-mentioned classes; for a suitable exchange of papers and periodicals; for mutual courtesies extended to members and visitors, and for a system of personal representation by which accredited members of local organizations would be admitted to the meetings of the national organization, whether members thereof or not.

We are obliged to considerably abbreviate the document, giving its substance.

American Water-Works Association, (continued from page 515)—On Friday there were excursions to Elgin, Ill., to see the process of the American Filter Co., and to Pullman, Ill. At 8 o'clock P. M. the final session was held when, the time being limited, the remaining papers were read by title only and ordered to be printed in the report of the Convention. Several resolutions of thanks were voted, and the Convention adjourned to meet in Philadelphia next year.

We publish herewith the discussion by Prof. Leeds on Mr. Le Conte's paper:

In opening the discussion on the paper of Mr. Le Conte, Prof. Leeds said:

Mr. President and gentlemen, I feel already well repaid to have come so far to attend this meeting, by reason of the value of the papers I have listened to, and more especially this one of Mr. Le Conte. Mr. Le Conte has rendered a most valuable service by his contribution—the result of his studies of a variety of phenomena, very obscure in their origin, and which have much perplexed the minds of engineers. He has presented in an elaborate paper the results of a number of observations made for a series of years upon the Pacific Coast, more especially upon the water supplies of the cities of San Francisco and Oakland.

And now, Mr. President, if you and the other members will allow me, inasmuch as I do not think the discussion would be very intelligent otherwise, before saying what I propose to on this topic, I shall give a brief resumé of the chief points of that paper.

In the first place, Mr. Le Conte brings into prominence the unusual physical conditions prevailing upon the Pacific Coast, and more particularly the climate. He thinks that we on this side have no adequate comprehension of the difficulties growing out of these conditions. Mr. Le Conte says that they are compelled to rely for their water supply upon the rain which falls in their winter season between the months of November and May. After this period, for a period of six months, they have no rain, and their storage system must be regulated accordingly. It is very usual for a whole winter to pass, and sometimes more than one, without any rain. The period of drought may extend to six hundred days, and they must have reservoirs to give them a water supply reaching over nine hundred days, or more than two years' supply. The city of San Francisco has three reservoirs on a scale of which we have little experience on the Atlantic Coast. One of these reservoirs has a capacity of 1,080,000,000 galls., the second 6,600,000,000, and the third 3,830,000,000. The amount of water supplied to the city from the first two reservoirs is 9,000,000 galls. a day, or only a little more than 1-1,000 part of their united capacity.

The city of Oakland, he further says, has a reservoir of 4,300,000,000 galls., supplying 23 million galls., per diem, or about 1 200th of its capacity.

In a very lucid manner he describes the life history, if I may so call it, of the water as it falls from the clouds, is impounded in the reservoirs, flows down from the aqueduct, and finally reaches the consumers. He divides this life history into three stages: First, the period of collection extending through the winter season up to the end of May. During this time the water is good, notwithstanding some light silt or mud is carried into it by winter floods. He makes the important observation that up to the end of this period of collection, the temperature of the surface water is forty-eight degrees Fahrenheit, of the bottom water fifty, and since the warmer water is below and the colder at the top, there goes on during this first phase of the life history, a constant circulation.

The second phase, he calls the period of fermentation. This sets in about the end of May. The surface of the water now acquires a temperature of 62°, while the bottom retains its temperature of about 50°. As a physical consequence, the circulation ceases and this period of fermentation is also a period of stagnation. The second phase of the life history is attended with a growth of phenogamous plants; that is to say, ordinary fresh water plants, plants capable of giving up oxygen, assimilating carbonic acid, supporting fish life, etc. Later, the era of fermentation is marked by the rising of bubbles all through the water, which consist of carbonic acid gas and carburetted hydrogens. As these gases increase in quantity, the dissolved oxygen diminishes and the vegetation changes its character. It is no longer phenogamous; it becomes cryptogamous, the familiar plants which flourish in lively water disappearing and the more obscure forms of vegetable life, the algæ, making their appearance.

Now comes another and more tragic phase of the life history: First, the youthful life with its beauty, then its development, then approaching decay. Now, there has arrived the last phase, which is that preceding death, and this last phase is one of putrefaction. When this has arrived the gases have changed their character. The oxygen has largely disappeared and carbonic acid gas and carburetted and sulphuretted hydrogen have taken its place. In the phase of putrefaction, decay is going on and whenever decay takes place in the absence of oxygen, it is dangerous and means death; it means the formation of septic poisons, fatal to both vegetable and animal life.

This period of decay ends with the close of October. In November the life history enters again upon a new cycle. The water becomes chilled as soon as the frosty nights set in. The chilled water sinks to the bottom, and once more circulation of the water in the storage reservoirs takes place, with consequent alterations and changes. Curiously enough, at this point the water, as shown by analysis, is at its worst. This is due to the circulation having been established once more. The warmer water rising from the bottom along with the gases brings mud and organic impurities to the surface. Mr. Le Conte emphasizes the fact that, while the water in the storage reservoirs is very bad, yet as it passes down the open flumes and aqueducts leading from the reservoirs, being in contact with the air in these open conduits, its quality continues to improve progressively until by the time it reaches the surface reservoirs it is at all times much better than the water in the impounding reservoirs. He further discriminates in this connection between the changes taking place and the resulting quality of the San Francisco water and the City of Oakland water. Both are provided with enormous impounding reservoirs; but the San Francisco water comes down through open conduits, and passes through screens placed at the service reservoirs within the city limits. The city of Oakland water, on the other hand, passes through screens placed near the storage reservoirs and then flows many miles out of contact with air before it is delivered to the consumers. It results from these differences that the quality of the water in San Francisco is far better than the city of Oakland water. Furthermore, in regard to the city of Oakland, an additional source of the offensive taste is in the pipe system. During the entire putrefaction stage in the storage reservoir the water in the pipes supplying the consumer is always bad. Mr. LeConte attributes this offensiveness to the mud in the surface pipes, and finds it to be so much the worse as this mud is excluded from the air.

In concluding this résumé of the paper, I will bring to your attention the palliatives proposed by Mr. LeConte. His first palliative consists in the removal of the mud from the reservoirs. He proposes to effect this removal by means of a pipe let down to the bottom, through which the mud should be pumped.

Secondly, the accumulation of the mud in the service pipes should be remedied by previous subsidence and sand filtration.

I have now given you as fair an idea of the contents of this valuable paper as I could from my recollection of it as read. I am deeply interested in this matter, but I should not refer to any points in my own experience or make any criticisms upon the palliatives Mr. LeConte proposes unless I felt sure you were willing to devote more of the valuable time of the convention to its consideration.

Mr. TUBBS: Prof. Leeds has probably given more attention to the examination of water supplies than I think any other person in this country, and I desire that he should give us the benefit of his views on this very valuable subject, and I now so move. Carried.

Mr. TUBBS: The professor has not gone quite far enough in this matter, and Mr. LeConte has not gone far enough. If the professor would favor us with a few suggestions, I should be personally pleased about it, and I hope the President will request him to make a few more additions to his remarks.

The PRESIDENT: It is the opinion of the Chair that the convention would like to listen further to Prof. Leeds.

Prof. LEEDS: In the first place, Mr. President, I am sorry that I have no personal knowledge of the climatic conditions prevailing on the Pacific coast. But the troubles which Mr. LeConte speaks of, are similar to those which baffle and perplex all of us, perhaps more than any thing else in connection with the palatability of particular water supplies. To show that these troubles are very common in the Middle and New England States, I would mention that in the summer of 1874, the state of affairs Mr. LeConte speaks of as chronic in these Californian storage reservoirs, occurred over the whole of the northern part of New Jersey. Mr. OWEN, our fellow member, said to-day that in accordance with the recommendations of the Water Commission of New Jersey the whole of the water supply which falls upon the Passaic water-shed of northern New Jersey, and which is 900 miles square in area, is to be parcelled out, and so many million gallons is to go to the city of Newark, so many to Jersey City, and so on. But while the remark made by Mayor HAYNES, of Newark, that this water is of great purity, is true of the water in its ordinary condition, yet, in the natural impounding reservoirs, which are the lakes all through this water-shed, the same trouble that Mr. LECONTE speaks of frequently occurs. In the summer of the year 1874, if I recall the date correctly, there was not a lake in this water-shed which did not present the same phenomena and go through the same changes of fermentation. The fish were affected by it, a vast number dying and rising to the surface, being killed by the poisons generated in this process of putrefaction. The country people recognize the recurrent character of this aquatic disorder, and denominate it the "purging of the water."

I spoke of New England. At Athol, Mass., for instance, the water is taken from a natural impounding reservoir and every season it goes through the same cycle. Not only the period of fermentation and of algæ, but of putrefaction attended by an intolerable stench. At Springfield, Mass., the Ludlow reservoir covers 550 acres, and they have tried a number of palliatives, especially gravel and charcoal screens, but without success. The water supply of Newburg on the Hudson, and very many other towns in the Middle States have their like periods of fermentation and putrefaction.

It is a mistake to suppose that this trouble takes place only in the warm season. Our friend, Mr. TUBBS, will back me up in the statement that in connection with the water supply taken from Hemlock Lake in Rochester, they have had trouble in winter quite as bad as in summer, due to the development of certain forms of algæ. There are certain kinds that will grow on the ice, and they have suffered on this account at Rochester in the month of February. The same thing is true of the water supply of Philadelphia in the winter of 1882. The water supply at Philadelphia comes mainly from the Schuylkill River, which has a daily flow of 300,000,000 galls. At that particular season, the river was coated with ice from Pottsville and the mining district down to the Fairmount pumping station. Many of you who visited the Centennial in 1876 will probably recall that there was a great many cases of typhoid fever among the visitors at Philadelphia at that time. The origin of the typhoid fever prevalent among the Centennial visitors was attributed to the polluted water of the river Schuylkill. I am glad that when we shall all come to Chicago, to your World's Fair, one of the exhibits which you can be most proud of will be your unlimited supply of unpolluted water. The examination of the water at Philadelphia in 1882 showed that it was very impure, but the cause of the offensive taste and odor was not revealed until the analysis was extended to the examination of the gases dissolved in the water. This examination showed that the oxygen had disappeared, and its place had been taken by carbonic acid and carburetted hydrogen. These changes had come from the putrefaction of the sewage contained in the Schuylkill water beneath the ice, and consequently out of contact with the air.

I shall have a few words to say with regard to the nature of the remedies that appear to be indicated. Mr. LECONTE dwells upon the importance of the removal of the mud from the bottom of the reservoirs, and on keeping it out of the pipes by subsidence and filtration. In reference to the former recommendation, I would add the importance of preventing the process of fermentation and putrefaction in the reservoirs, by eliminating the dissolved carbonic acid and carburetted and sulphuretted hydrogen by means of excess of oxygen. These two objects are being carried out in a number of places by artificial aeration. Water, after this treatment, does not require preliminary subsidence. Its suspended mineral matters can be completely removed by precipitation and filtration, which at the same time removes all other particles however minute, including the spores of bacterial and cryptogamic life.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIII. Saturday, June 7, 1890.

D. McN. STAUFFER A. M. WELLINGTON
EDITORS.
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ASSOCIATE EDITORS.
GEO. H. FROST.....BUSINESS MANAGER

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Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if those who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia, Pa.—Next meeting, June 7. Secy., Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Next meeting June 9. "Municipal Surveys," D. W. Pike. "The *City of Paris* Accident," by R. Gillham. Secy., Kenneth Allen, 900 Baird Building.

Master Car-Builders' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 10. Secy., J. W. Cloud, Buffalo, N. Y.

Civil Engineers' Club, Cleveland, O.—Next meeting, June 11. "Ferrold, an artificial stone," Dr. H. Poole. Secy., C. O. Palmer, 29 Cedar Ave.

New England Railway Club, Boston Mass.—Next meeting, June 11. Sec., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, June 11. Secy., J. C. Herring, Wichita.

New England Water-Works Association.—Annual Convention at Portland, Me., June 11, 12, 13. Secy., R. C. P. Coggeshall, New Bedford, Mass.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, June 12. Secy., Clement March.

New York Railway Club.—Next meeting, June 12. Rooms, at 118 Liberty St.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, June 12. Secy., Olin H. Landreth, Vanderbilt University.

American Railway Master Mechanics' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 17. Secy., Angus Sinclair, 140 Nassau St., New York.

Western Railway Club, Chicago, Ill.—Next meeting, June 17. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, June 17. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, June 18. Secy., S. E. Tinkham, City Hall.

American Society of Civil Engineers, New York.—Next meeting, June 26. Annual convention, at Cresson, Pa. Secy., John Bogart, 127 E. 23d St.

Western Society of Engineers, Chicago, Ill.—Next meeting, July 4. Secy., J. W. Weston, 230 La Salle St.

Association of Civil Engineers, Dallas, Tex. Next meeting, July 2. Secy., E. K. Smoot, Elm and Austin Sts.

Civil Engineers' Society St. Paul, Minn.—Next meeting, July 7. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of St. Louis, Mo.—Next meeting, Sept. 17. "The Telescope," by O. L. Petitdidier. Secy., W. H. Bryan, 309 So. 7th St.

THE summary of American and British railway accidents to persons, which appears in another column, is noteworthy as the first and only one of the kind which it has ever been possible to make, owing to the fact that never before this week has there been a sufficiently accurate record of the total casualties, resulting from the operation of American railways, or of any particular class of casualties, to make comparison possible. The Interstate Commerce Commission has published some general records of the kind for a year or two past, which were a great advance on what has been before available; but only this week do they make public what can fairly be called a detail statement, making comparison possible with the excellent British records, which have been kept for many years. The record on the whole is a creditable one to us, and we have no doubt will grow still more so, as the British records have, if the Interstate Commission follows the British policy of making these records public in detail, with (in this country) totals by States and groups of States. The public and the railways are to be congratulated on the appearance at last of something like a correct record of our railway accidents. It shows about 2½ times as many train accident casualties alone as have been caught in the unofficial record which has heretofore been the only source of information.

THE *Evening Post* of May 27 quotes at some length from the report of the technical commission of the Panama Canal, and among the rest, this statement, containing an important typographical error:

> . . . The annual rain fall is about 118 ins., or six times greater than that of the Valley of the Seine. The effect of these enormous floods falling upon an impermeable soil is to transform the rivers into swift and dangerous torrents. The most important of these, the Chagres, through the valley of which the canal runs for more than half of its length, sometimes rises 40 or 50 ft. within 36 hours, carrying a volume of water not less than 5,000 cu. ft. per second and possibly twice that amount at its maximum. The difficulties of controlling or diverting such a stream may be readily understood.

The "5,000" cu. ft. in this statement should read "50,000" cu. ft. per second; and instead of this being "possibly" doubled, we understand that at times the discharge rises to 165,000 cu. ft. per second; or nearly half the quantity which flows over Niagara Falls. Such a discharge continues, of course, but a short time, but its effect is almost as bad while it lasts as if it went on forever. We have not given much space to the details of this report. "The coon is too dead to skin." But it is not surprising to learn that the 500 fr. shares which stood at 54 fr. before the general report was published, and at 42 fr. after it, fell to 28 fr. after the geological report was published.

THE formal consolidation of the St. Louis & San Francisco railway system, with the Atchison, Topeka & Santa Fé, briefly noted May 24, is now an accomplished fact. Messrs. J. & W. Seligman & Co., who held the controlling interest in the St. Louis & San Francisco Co., agreed to exchange their shares for Atchison common stock. To effect this purchase the Atchison stock is increased $27,000,000, of which all but about $700,000 goes to the St. Louis & San Francisco stockholders. This makes the total capital stock of the Atchison Company $101,285,175. The total extent of the consolidated system is only 33 miles short of 9,000 miles, making the capital stock per mile $11,296.

The most important thing gained by the new acquisition is the certain control of the Atlantic & Pacific Railway, which was owned jointly by the two companies now consolidated. Had this half interest been purchased by one of the Atchison's active competitors, that company's connection with its California lines would have been seriously endangered. The second great point gained is an entrance to St. Louis, the only important centre in the Southwest which has not been reached by the Atchison system. A study of our map of the railway systems of the Southwest, in our issue of July 20, 1889, shows that the consolidated Atchison system can command a much larger proportion of the traffic between St. Louis and the Southwest than the St. Louis & San Francisco could. Its only competitor for this traffic is the Gould system, and for a large belt of Southern Kansas, which constitutes the most productive portion of the State, the Atchison will have much the shortest line. On St. Louis-Texas traffic, too, the Atchison is now the only competitor offering a through line under one control and reaching all the principal Texas centers.

ALMOST inevitably the consolidation will lead to the construction of some important extensions. By purchase or construction the completion of a Chicago–St. Louis line by the Atchison seems exceedingly probable. Perhaps the perennially bankrupt St. Louis & Chicago, which runs over just the route which the Atchison should take to complete its line, will be quietly bought up. Other probable extensions of less importance are from Sapulpa to Oklahoma, giving St. Louis a chance to compete with Kansas City for the trade of that Territory, a line from the terminus of the Wichita & Western at Mullinville, Kan., to Dodge City, and possibly an extension of the Texas Panhandle line to strike the transcontinental road in New Mexico, and a line from St. Louis to Kansas City.

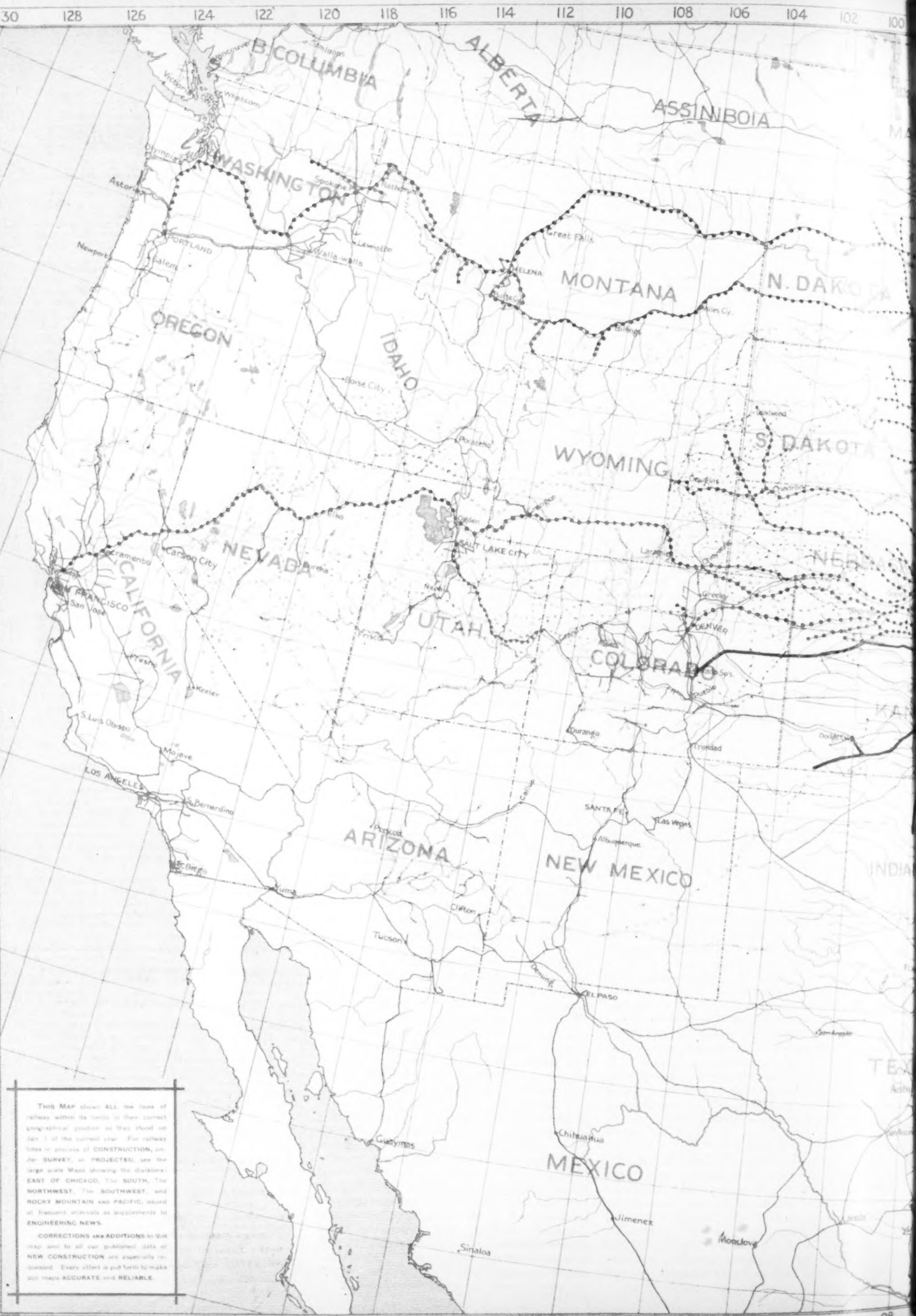
But doubtless most of these extensions are a considerable distance in the future; the men at present in control of the Atchison property are likely to be very conservative on the subject of new construction, at least until the experience of 1887 is forgotten.

CONSOLIDATION is evidently far from being at an end. The recent absorption of the Queen & Crescent system by the Richmond & West Point Terminal Co., is another recent instance, which, by the way, brings up that system well toward the Atchison's position as regards mileage. The figures for these and some of the other largest systems are now as follows:

System.	*Mileage.*
Atchison, Topeka & Santa Fe	8,966
Richmond & West Point Terminal	8,386
Union Pacific	7,796
Pennsylvania	7,664
Chicago & Northwestern	7,156
Vanderbilt lines east of Chicago and St. Louis	6,939
Chicago, Burlington & Quincy	6,877
Southern Pacific	6,052
Canadian Pacific	5,935
Chicago, Milwaukee & St. Paul	5,678
Missouri Pacific	5,094
Total	76,543

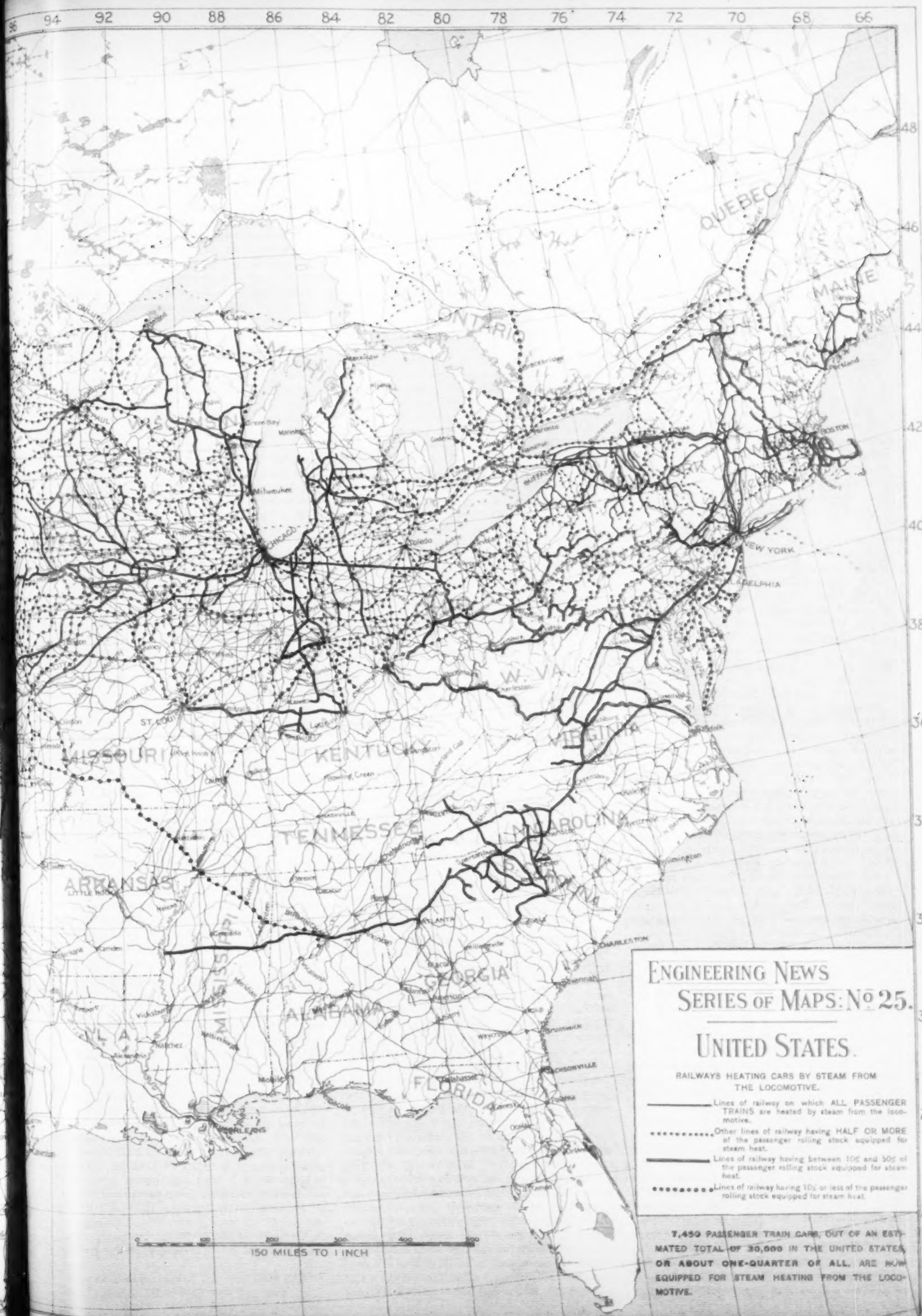
It thus appears that the above 11 companies operate about one-half the mileage of the United States, and even this does not indicate their real relative importance, since their lines include those of heaviest traffic. Probably at least five-eighths of the railway traffic of the country is handled on the above systems. It will be at once noted that the many systems with an extent of 500 to 5,000 miles, have no place in the above table. Considering the immense mileage and traffic which they control, it may be realized how completely the day of small things in railroading has passed. The only probable end to the progress of consolidation seems to be the division of territory among a very few enormous systems. The present competitive system of railway traffic plainly can last only a few years longer.

No one can look at the map showing the gratifyingly rapid progress of steam heating from the locomotive which appears in this issue, and not see that one piece of mandatory legislation, at least, has done good. New York is the one State which passed a law compelling the use of steam heat last winter. It is the one State in which a great deal has been accomplished, and it is also very easy to see from the map that the influence of the New York law radiated from the State in



THIS MAP shows ALL the lines of railway within its limits in their correct geographical position as they stood on Jan. 1 of the current year. For railways lines in process of CONSTRUCTION, under SURVEY, or PROJECTED, see the large scale Maps showing the divisions: EAST OF CHICAGO, The SOUTH, The NORTHWEST, The SOUTHWEST, and ROCKY MOUNTAIN and PACIFIC, issued at frequent intervals as supplements to ENGINEERING NEWS.

CORRECTIONS and ADDITIONS to this map and to all our published data of NEW CONSTRUCTION are especially requested. Every effort is put forth to make our maps ACCURATE and RELIABLE.


ENGINEERING NEWS
SERIES OF MAPS: No 25.
UNITED STATES.
RAILWAYS HEATING CARS BY STEAM FROM THE LOCOMOTIVE.
Lines of railway on which ALL PASSENGER TRAINS are heated by steam from the locomotive.
Other lines of railway having HALF OR MORE of the passenger rolling stock equipped for steam heat.
Lines of railway having between 10% and 50% of the passenger rolling stock equipped for steam heat.
Lines of railway having 10% or less of the passenger rolling stock equipped for steam heat.
7,450 PASSENGER TRAIN CARS, OUT OF AN ESTIMATED TOTAL OF 30,000 IN THE UNITED STATES, OR ABOUT ONE-QUARTER OF ALL, ARE NOW EQUIPPED FOR STEAM HEATING FROM THE LOCOMOTIVE.
150 MILES TO 1 INCH
QUEBEC
ONTARIO
MAINE
BOSTON
NEW YORK
PHILADELPHIA
CHICAGO
Milwaukee
Toledo
Buffalo
W. VA.
VIRGINIA
KENTUCKY
MISSOURI
TENNESSEE
ARKANSAS
ATLANTA
CHARLESTON
GEORGIA
ALABAMA
MISSISSIPPI
Vicksburg
Natchez
Mobile
NEW ORLEANS
JACKSONVILLE
FLORIDA
Tallahassee
Tampa
Orlando
Brunswick
Savannah
Wilmington
Memphis
Nashville
Louisville
Cincinnati
Columbus
Detroit
St. Louis
Kansas City
Omaha
Minneapolis
Duluth
Winnipeg
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all directions, causing a perfect network of lines between it and Chicago to have more than half their passenger stock equipped already, for example. In New England, also, the great bulk of what has been accomplished has been on lines running into New York State, the Maine Central, Old Colony, and one or two others being honorable exceptions. The Maine Central was one of the very first roads on the continent to move in this matter, but, except for it and the lines running into New York, the New England lines in color would not cut a much better figure on our steam heating map than they did on our freight brake and coupler map. The Virginia lines make a very honorable showing, but the South generally is moving somewhat slowly, as is but natural. The roads which have heretofore hung back will not be likely to do so much longer, however, in view of the proof of general activity which our map affords, and by the end of next winter we expect that a second edition of our steam-heating map will show vastly greater progress still. As it is, it must always be remembered that the actual rate of progress is even greater than the map indicates, owing to the fact that the lines which have done most are the lines of heaviest passenger traffic. *One-quarter* of the total of passenger train cars in the United States is already steam-heated; but not nearly one-quarter of the mileage is shown in red.

We learn that the further records, published in our issue of May 24, of Janney freight car coupler breakages on the Chicago, Burlington & Quincy, sufficiently favorable as they stood, did injustice to the coupler in two important respects: First, the number of couplers in use was much greater than we stated. We gave it as 1,183, all we had certain knowledge of. As a matter of fact, there were in use on the road on Jan. 1, 1890, 2,093 couplers, or nearly twice the number we gave. We are authorized to state that the average number in service was fully 1,500. Secondly, and still more important, and unknown but considerable proportion of the knuckle failures were from passenger stock, including *all* the 12 "worn-out" knuckles, so far as can now be ascertained. Passenger knuckles naturally wear out much more rapidly than freight, because they are held together with all the force of the buffer springs, amounting to several tons. These "worn-out" knuckles alone were over one-sixth of the failures reported. All things considered, therefore, a true showing of this latest quarter's experience would be about three times as favorable as appears from the "face of the returns," perhaps bringing it into close correspondence with the average fall prior experience, as presented in detail in our issue of Feb. 15, 1890.

Practical Experience in Heating Cars by Steam from the Locomotive.

We present to our readers with this issue a map and table giving the only full and complete information as to the progress of steam car heating that has yet been published. A year ago some statistics on this subject were collected by a committee of the Association of North American Railroad Superintendents. The committee in charge of the matter received reports from 38 roads, of which 20 only were using steam heat. The total equipment fitted for steam was 1,418 cars. Our table gives the record of 86 different companies using steam heat, controlling a total of 91,443 miles of railway and having nearly 7,400 cars (*or about one-fourth of the total passenger rolling stock in the country*) equipped for steam heating. We are confident, therefore, that practically all the steam car heating now in progress is shown on our map and table.

The great advantage of our map series in showing at a glance what otherwise can only be attained by long and wearisome study of figures will be especially appreciated in the present number, we think, by all our readers. The large table elsewhere gives the figures of the mileage in each stage of progress in each section of the country; but the map gives the same and more information in graphic form, so that even the most hurried reader can see and comprehend it.

At the time of the White River disaster three years ago, ENGINEERING NEWS was the only technical journal which affirmed the practicability of heating cars by steam from the locomotive, and predicted the ultimate success of that system, on the ground of both safety and economy. All the other technical journals either declared the idea impracticable or preserved a discreet silence. That over one-fourth of the passenger rolling stock of the country is now equipped for steam heating, after extended practical trials and in the face of much opposition, thoroughly proves the correctness of the position we then took. It is a fact on which the traveling public has abundant reason to congratulate itself, and in which we naturally take especial satisfaction. We then (Feb. 19, 1887) declared that the Woodstock disaster was "more than likely to bear permanent fruit in a gradual change of our system of car-heating." It is now entirely clear that the whole great movement which has now reached such magnitude began then. In the same article we specified five years as a sufficient time for the use of steam-heat to become general. In three years it has already become so.

The blanks sent out by us for obtaining the information from which this table has been prepared contained questions concerning the difficulties met with in the use of steam heating, and as may be seen by an examination of the list of answers to these questions given in the table, the success in heating cars from the locomotive has thus far been equal to what its warmest friends could expect. The roads whose experience has been longest and who are using steam heat most extensively are the ones which are strongest in their praise of the system and its working, while the few reports of trouble come generally from roads which have recently begun the introduction, or whose use of steam heat is still limited.

We have elsewhere discussed at length the facts which are presented in the table, and which are faithfully set down as reported to us. While at the present season the room of a steam heater may be better than its company, it is by no means too soon to canvass the action which is to be taken for the coming season, and see how far theory and experience harmonize as to the best method to be used in warming cars.

Since the first reason urged for the use of steam heat from the locomotive, was the danger from the common car stove, it may be asked first whether steam heating is safe. The careful and lengthy experiments made by the Massachusetts Railroad Commission in 1888, summarized in our editorial of March 23, 1889, proved that with direct steam, at 80 lbs. pressure, the escape into the car from an open valve on a 1¼-in. pipe was not enough to make it necessary for the occupants of the car to leave it, however long the discharge was continued, provided the doors and windows were opened in four or five minutes, even with high pressures. The jet would not burn the hand three feet from the pipe. Yet we still hear much of the dangers from steam scalding from heater pipes. Even the Pennsylvania Railroad officials claim as one advantage of their low pressure return system over direct steam, its perfect safety in case of ruptured pipes; an advantage which, we think, is not entitled to great weight, although the vacuum system with which the Pennsylvania is experimenting has much to commend it otherwise. Just how it is possible to prove that steam heating is safe if the Massachusetts experiments do not prove this, it is difficult to see. The results of experience, which have thus far shown no record of scalds from escaping steam, are good as far as they go; but, of course, it may be claimed that the conditions have not yet been just right to cause an accident.

Certainly theory is quite consistent with the results of the Massachusetts tests, as far as direct steam is concerned. The amount of steam stored in the heating coils is small, and the friction of the steam in its flow from the engine through the train pipe to an open orifice in the cars is sufficient to prevent any dangerous outpour of steam from a ruptured pipe. The pressure may be high before rupture, but as soon as an escape is open it falls almost to nothing at the orifice. In a hot water heating system, on the other hand, the amount of heat stored in the radiating coils is very considerable. A rupture of a pipe in a coil containing water under 80 lbs. pressure would certainly be a much more serious matter than a similar rupture in a steam pipe. But 80 lbs. pressure is seldom or never carried; and with hot water systems pressures are generally very low, and can be as well as not, since the heating pipes have no direct connection with the steam pipe from the engine. Thus a hot water system may be run entirely at ordinary atmospheric pressure if desired. That there is no possible danger from hot water at pressures up to 5 lbs., at least, will certainly be conceded.

The next question, and one which is being discussed very vigorously, is whether steam heating is comfortable, or rather, whether it can be made comfortable by reasonable care on the part of the trainmen. This is to some extent a question between different systems. The "difficulty in regulating temperature," which several of our correspondents report, indicates that complaints of overheated or underheated cars have been coming in to them. It is to be especially noticed that all the companies which report this difficulty are using *direct* steam. Now, there is nothing at all strange in the fact that a car heated by steam, which is just right when the thermometer outside is at 20°, should be oppressively warm when the thermometer rises to 50°, and uncomfortably cold when it falls to −10°. If all the radiating pipes are constantly filled with steam, then the only change in the amount of heat given off must be due to changes in the pressure of the steam. Let us suppose that when the above changes in the outer temperature occur the steam piping is so well arranged that a difference of pressure of 35 lbs. can be secured, the range being from 5 to 40 lbs.; also that the temperature of the interior of the car be 70°. The following will be the respective differences in temperature between the steam pipes and the car, and the outer temperature and the car.

Temperatures of outer air.	Temperatures of car.	Difference.
−10°	70°	80°
20°	70°	50°
50°	70°	20°

Pressures and temperatures of steam	Temperatures of car.	Difference.
5 lbs.... 228°	70°	158°
25 lbs... 267°	70°	197°
40 lbs.... 287°	70°	217°

According to NEWTON'S law of cooling, the radiation is proportional to the *difference* of temperature. Then the radiation from the car to the outer air, according to this law, would be four times as great when the mercury was at −10° as when it was at 50°, while the steam pipes could be made to radiate only about 1½ times the heat at 40 lbs. pressure which they did at 5 lbs.

To make this matter somewhat clearer, suppose 40 lbs. pressure (giving 287° temperature in pipes, or 217° more than the temperature of the interior air) just suffices to maintain 70° in the car, with the exterior air at − 10°, or 80° colder than the interior air; then if the outside temperature be only 20° colder than the interior, or + 50° Fahr., we only require one-fourth as great difference between the temperature of the pipes and the air to maintain 70° in the car. But one-fourth of 217° is

only 54°, which added to 70° = 124° as the proper temperature of the pipes to heat the car as effectively as may be done with 40 lbs. of steam (287° Fahr.) with the outside air at —10°. The following table gives the different temperatures:

Outside air.	Inside air.	Diff.	Ratio.	Tem. pipes. (40 lbs =)	Diff. from inside a r.	Ratio.
—10°	70°	80°	4	287°	217°	4
+50°	70°	20°	1	124°	54°	1

In order to get four times the amount of heat radiated from the steam pipes when the mercury is at —10° outside, we must have about four times the *difference* in temperature between the car and the steam pipes. This is impracticable with steam, since the extreme attainable range in temperature of the radiating surface is only from 287° down to 212°. With a hot water system, on the other hand, the lowest temperature in the radiating pipes may be as much less than 212° as is desired. To get a variation of four times the amount of heat given out with a hot water system, we might have the following:

TEMPERATURES.

Outer air.	Car.	Difference.	Radiating pipes.	Car.	Difference.
50°	70°	20°	110°	70°	40°
—10°	70°	80°	230°	70°	160°

Ratio between differences, 1 to 4.

Of course it is not meant that this law applies with mathematical exactness, and, indeed, it is really only an approximation. The differences in ventilation in warm and in cold weather, etc., make knowledge of the exact relative heat required impossible except by experiment. But though the law is not exact, it is true within reasonable limits, and furnishes the scientific explanation of the great facility with which a hot water system may be modified to meet extremes of temperature.

Experience thus far seems to show, however, that direct steam can be so handled, with reasonable care and vigilance, as to make passengers comfortable in all ordinary weather. There is a widespread belief that, for use in the Northwest and on Canadian roads, where blizzards have to be faced and the mercury occasionally draws itself into the bulb, heating from the locomotive is not practicable, but by the indirect system supplementary fires in the cars may be used in case of urgency.

Of the roads in our table the Maine Central, New Brunswick, and Delaware & Hudson Canal Co., all of which are using steam heat extensively, are likely any winter to have to meet temperatures of —35° or so, although even this is doubtless not as bad as a Dakota blizzard. Thus far these roads seem to have found no difficulty in regulating temperature. Indeed, Mr. BLACKALL, of the first road, states that he can keep the temperature at any point desired. He is using, however, a hot water system.

It may safely be stated, therefore, that by providing radiating surface enough and using a hot water system passengers can be kept comfortable on the most northern roads where the weather is most severe. It is possible, too, that by arranging to vary the amount of heating surface exposed, and by using thermostats, the direct steam system can be made equally applicable to the Canadian and Northwestern roads. This, however, is merely one of the possibilities of the future, and so far as we know has not yet been attempted.

The bugaboo of which the technical journals were full at the time of the popular outcry against the "deadly car stove" in 1887,—the draft on the locomotive—has proved to be a very empty sort of scare-crow, as we then (Feb. 19, 1887, page 125) predicted would be the case. It was gravely asserted that the locomotive boiler had all the work now that it could do, and that to ask it to furnish more steam would be the last feather which would break the motive power department's back.

Yet, as shown elsewhere, those using steam are now almost unanimous in the assertion that there is no appreciable increase in fuel consumption. It is not at all difficult to see why this should be so. Taking the steam per hour per car for heating at 65 lbs., a 6-car train would require 390 lbs. steam per hour, which would require the combustion of, say, 65 lbs. of coal. As in that length of time the train may run, perhaps, 40 miles and use 2,400 lbs. of coal, it is plain that the fireman who measures the coal by the shovelful would never notice the extra 65 lbs. if it were used. The only point of real importance, then, is whether locomotives hauling fast trains or trains on steep grades do feel even this slight increase of two or three per cent. of the steam used. Experience seems to clearly indicate that steam heating has nothing to fear from this obstacle. The reports to us mention nothing of it as a difficulty save in one case, where steam is also used to drive an electric light engine.

The question of the economy of steam heating has generally been studied on the basis of the amount of water condensed. A much better method seems to be to compare the relative efficiencies of the car stove and the locomotive furnace as generators of heat. We know of no experimental evidence on this point, but it needs little examination of a car stove to convince one that beside it the locomotive furnace is a model of efficiency. The stove's loss through unburned fuel, air excess passing through it, and excessive temperature of gases passing from smoke-pipe, must largely exceed the similar losses in the locomotive. But this is not the only source of gain. The train often takes heat from the engine which would otherwise be blown off at the safety valve, and the locomotive uses a grade of fuel costing often less than half as much as that burned in the stoves. Taking this latter item alone, and assuming the consumption of coal per car per hour by the stove to be 10 lbs.; for a four-months' run at 12 hours per day 14,400 lbs. of coal would be required, which at $4.50 per ton would cost about $30 for the season. This is certainly an inside figure. It is probable that in the Northwest the coal for car heating costs $50 or more per car per year. Therefore, taking the most favorable possible showing for the stove, namely, that it is as efficient as the locomotive furnace, and we have one-half the cost of fuel saved, or $15 to $25 per car per year, a sum more than sufficient to pay the interest on the cost of steam heating appliances over the cost of the common stove.

To the various questions with regard to steam car heating, then: Is it safe? Is it comfortable? Is it practical? Is it economical? both theory and experience give an affirmative answer. These being the incontrovertible facts, it may be confidently expected that the next two years will see even a greater advance than the past two.

It is to be hoped that the railways which have still done nothing in this important reform may be led to take action upon it now that its practicability from every point of view is fully proved, and not wait until some other great holocaust stirs up legislators to compel that action which the railways ought to take voluntarily for the safety and comfort of travelers. As we said over three years ago we repeat now: "We do not envy any railway manager who may chance to have a carload of passengers burned up a year from now and who is not able to show that he has at least made a start toward the equipment of his passenger cars with steam heat."

An Extraordinary Correspondence.

It is putting it mildly indeed to characterize as "extraordinary" only the correspondence which appears in another column between the McConway & Torley Co., manufacturers of the Janney car coupler, and Mr. F. D. ADAMS, Master Car-Builder of the Boston & Albany Railroad. That it might justly be called something more specific than "extraordinary," a brief summary of the facts will strongly indicate.

In our issue of Feb. 15 we published a very full summary of the breakage record of 45,617 Janney freight couplers on 11 important railway systems, rejecting imperfect record for half as many more couplers. These records showed that, with a truly remarkable agreement among the different companies with the average results, taking all the breakages occurring on all these lines together, 1 per cent. of the couplers and 3 per cent. of the knuckles were found to be breaking yearly, making the *present* maintenance rate per car only 29 cts.*

About a month later (March 12) the New England Railroad Club had a meeting, at which Mr. ADAMS read a paper purporting to have been prepared by Mr. JOHN M. FORD, a clerk in his office, and purporting to set forth a Boston & Albany experience of a very different kind. A detail table was given, having every outward appearance of being based on *bona fide* reports; and the facts therein stated, with the only possible explanations of this "conflict of evidence" which then seemed to us possible, we thus summarized, May 3, 1890:

> Now, in the face of these figures [our own, as above noted] along come officials of a minor road (for such the Boston & Albany is in comparison with the great systems above), operating not 21,507, but barely 200 miles of main line, and having not 45,617 Janney couplers on its own cars, but not a single one, and declares that in two months it had 296 fractures of Janney couplers, whereas the 11 companies operating 21,507 miles only reported 1,469 fractures in nine and one third months. Supposing that this statement of the smaller road is literally accurate as to time and number of fractures, which we greatly doubt, what do these facts prove? Nothing, surely, but that out of its own mouth the small road is condemned of needlessly rough usage of couplers, since other roads of 50 times their mileage and traffic seem to avoid such results easily enough.
>
> What we suspect to be the case is that the statement of 296 broken Janney couplers, and 347 M. B. C. couplers of all types, which the Boston & Albany officers state in italics is "*for two months*," is in reality a lot of breakages *collected* in two months from breakages which had been occurring for two or three years. That there is no such experience in the rest of the country is sufficiently evident by referring to the map in our issue of Dec. 21, 1889, showing the rate of introduction of automatic freight brakes and couplers.

One of the statements in this paper, read and indorsed by Mr. ADAMS, was the following:

> If it costs for two months, on 200 miles of road, $2,038.20, it would cost for one year $12,229.20. This would give the cost per mile per year, $61.14. If, therefore, one mile of road costs $61.14 per year, 156,082 miles would cost $9,542,825.48. Now, the editor of the ENGINEERING NEWS claims that there are about 56,000 cars, in round numbers, equipped with the M. C. B. coupler type. It would, therefore, cost per year to MAINTAIN the M. C. B. coupler on this 56,000 cars, *per car*, $170.40, or between six and seven sets per car per year.

Now we come to the correspondence given elsewhere. The manufacturers of the Janney coupler were naturally astounded at the appearance of a record from a road which was *not* using their coupler in such radical conflict with the returns received from the many roads which were using it, and on March 15 addressed a preliminary inquiry to Mr. ADAMS, asking if he had been correctly reported, as a preliminary to further investigation.

Mr. ADAMS replies, March 18, three days later, saying he "did not say we had broken so many [*i. e.* 347] Janney couplers, but that we had *broken* [all italics ours—ED.] on our road in 60 days 347 couplers of the Janney type, and I say it again." This is literally true, but what Mr. ADAMS' table did say, but he evaded admitting in this letter, was that 296 Janney couplers and 41 others of the Janney type had been broken, the 296 being almost as bad a record as the whole 347.

The McConway & Torley Co. responded, March 26, eight days later, noting this apparent evasion and asking how many of *their own* make of couplers had failed, adding the caustic comment:

> We have had no reason to expect a very heavy return of breakages from your line, as we find that the total

*ENGINEERING NEWS, May 3, 1890.

amount of materials furnished you, upon requisitions for repairs of Janney couplers, is only 12 knuckles.

In addition to the favor which we ask above [a detail record of the 347 or 296 fractures], we again beg that you will accept our proposition of Oct. 20, 1889 [five months before], at which time we wrote you: "If you have any broken Janney freight couplers or wrought iron knuckles in your scrap heap, we should be very glad to have you avail yourself of the foregoing proposition and send them to us for test and replacement as proposed."

This proposition, a standing one open to all users of the coupler, as we understand it, is to replace free of charge any coupler failing from original defect, which is found in practice to include about two-thirds of all that fail, and to exchange two broken or injured knuckles for one sound one, regardless of the cause of failure. Thus half the cost of knuckle renewals and two-thirds of the cost of coupler renewals is saved to the company, making it an act of folly for any company not to avail itself of this offer. Yet, in the face of this proposition made Oct. 20, 1889, Mr. ADAMS, or Mr. FORD for him, stated explicitly on March 12, 1890, near the end of the paper read as above: "*We have never been asked by the manufacturers of the Janney coupler* to furnish a report of the cases of broken or defective Janney couplers."

What does Mr. ADAMS respond to this most reasonable request and favorable offer? To the letter of Oct. 20, 1889, we are informed that he did not respond at all. For his answer to the renewed offer, March 26, we must refer to his letter of March 28, in another column, for a full answer. He "does not wish to continue any controversy or correspondence." He "prefers to let this be the end of it," not unnaturally. He "will say that we find of the Janney 58 bars broken, and, besides these, 238 knuckles broken." He has "no doubt others *do as we do: make a pattern and get them made at some place where steel castings are made—that is what we do*—so that the record that is published in ENGINEERING NEWS *is not worth anything*, only to mislead the managers of roads." In other words, Mr. ADAMS distinctly commits himself to the assertion that all the 296 breakages he has reported have been genuine breakages, and that the only reason for the seemingly striking contrast between this great number of breakages *in two months* and the small number of repair parts ordered of the makers *in five months*, viz., 12 knuckles, of which only 7 had been used, the other 5 being still in the repair shop at Allston, was that he was having, and did have, cast steel parts made to replace the other breakages; in other words that he had had 58 coupler and 238 — 7 = 231 knuckles, cast in steel.

Was this in fact done, or was it not? There is a loud call on Mr. ADAMS to answer that question circumstantially. Inasmuch as the makers themselves have never ventured to use cast steel for the couplers, and strongly advise against the use of steel for knuckles, it would be a hardly defensible procedure mechanically, apart from the financial loss in doing so, by neglecting to avail oneself of an offered free renewal of half the knuckles and two-thirds of the couplers. It certainly seems very strange that the five knuckles over from those ordered of the manufacturers should not first have been used up, and one would naturally expect, furthermore, to find a considerable stock of these cast-steel parts about the yards and scrap-heaps if they were being used for renewals on such a scale. We are informed, however, that not one of these is discoverable.

We now return to the correspondence, which was not renewed until May 10, or 42 days afterwards. Mr. MCCONWAY in the mean time made a careful ocular examination of the yards and scrap heaps along the whole line of the Boston & Albany, as he states in the beginning of his letter.

Mr. MCCONWAY then makes a distinct charge that he found the record of alleged breakages, which he justly states could only be interpreted as meaning that that number of parts had failed and been renewed, was on that basis wholly untrue, the record having been made up by noting every trifling defect "of any character whatever, as for instance, a crack or a chip out of a coupler or knuckle; that this cracking or chipping did not necessarily occur on your line, nor did it in any way disable the coupler or render it unsafe, and further, that few, if any, of the breakages or defects were repaired by you."

Mr. MCCONWAY further and justly says that such an explanation "necessarily calls into question your good faith and veracity," and that he deems it, therefore, but just to give notice of his intention to make it and the whole correspondence as public as was the original paper, in order to give full opportunity for any corrections or explanations, if there are any to offer. He adds with equal force and truth: "We beg to remind you that you cannot make a public statement affecting private interests, as you did at the March meeting, and successfully dismiss the further consideration of the subject by a captious declaration that 'you do not wish to continue the controversy.'"

This should go without saying, but to this letter Mr. ADAMS has not up to the present writing, nearly a month later, attempted any response.

To comprehend the full meaning of this correspondence a few further facts should be noted, not directly referred to in it. Mr. MCCONWAY assures us that in his personal examination of the yards, shops, scrap-heaps and repair shops of the Boston & Albany he found no sign of any cast-steel or repair parts being in stock, or ever having been, other than the five knuckles above referred to as remaining out of the twelve shipped to the Boston & Albany some five months ago. Neither could he find in the scrap-heaps any evidence of more than a very few fractures of knuckles or couplers; quite as small a number as other lines report which were listed in our issue of Feb. 15.

Again, taking the alleged 58 coupler fractures and 238 knuckle fractures to have all actually occurred, Mr. ADAMS obtains the alleged cost of $2,038.20 for making good these fractures, by charging $13.00 for each broken coupler, and $4 20 for each broken knuckle, including labor of renewals. At these rates, the cost charged for renewing the alleged broken January parts would be $1,754.60. But at the manufacturers rates the gross cost of these breakages would be:

For 58 couplers @ $8.50	$493
For 238 knuckles @ $4.00	952
Total gross cost	$1,445

And as two-thirds of these couplers and half of these knuckles would have been renewed by the manufacturers without extra charge, the actual cost to the Boston & Albany of renewing all the parts said to have been broken should have been:

For the 58 couplers (⅓ of $493)	$164
" 238 knuckles (½ of 952)	476
Total visible cost to the B. & A. R. R.	$640

There is a great void between $640 and $1,754.60, which a reasonable labor charge would diminish but little, indicating that the probable cost of making good all the alleged fractures has been exaggerated nearly three-fold, in addition to the much greater exaggeration in number of fractures distinctly charged by the McConway & Torley Co.

It is possible that there is some adequate explanation of these discrepencies, which on their face admit of but one interpretation. We need not say that if there is, we shall have great pleasure in making it as public and prominent as we do this correspondence. It is possible that some of Mr. ADAMS' subordinates have been guilty of a particularly mean imposition upon him and upon the public. If so, they should be exposed. But the policy of silence will not suffice in the face of such serious and circumstantial charges as are implied in the correspondence herewith. These questions can but arise and imperatively demand an answer. Were there, in fact, any 58 Janney coupler fractures in the two months referred to, or in five months? If not, how many were there? Were these 58 couplers all renewed? If not, why were they classed as fractures? If yes, can the scrapped parts be shown unaccounted for? Were the renewals made with special steel castings? If yes, where were the castings made? How many were made? Why were they made, instead of returning them to the manufacturers and getting two-thirds of them renewed free? Were there, in fact, any 238 Janney knuckle failures in the same period? If not, how many were there? Were they all renewed? If not, why were they classed as fractures? If all renewed can the scrapped parts be shown or accounted for? Were the renewals made with special steel castings? If yes, where were the casting made? How many were made? Why were not the remaining five of the dozen knuckles ordered five months before first used up? Why were special castings made instead of returning the knuckles to the manufacturers and exchanging two old knuckles for one sound one? Are the old knuckles in stock to do this yet? If not, where are they?

Amenities of Kentucky Railroading.

The following queer story comes to us through the Louisville *Courier-Journal*. Whether it is an actual occurrence, or "a fake" ingeniously gotten up for the benefit of our foreign cousins to illustrate the picturesque and variegated features of railroading in Kentucky, we must leave our readers to judge.

Engine No. 108 left Corbin, Ky., early on the morning of the 23th inst., bound for Pineville, on the Cumberland Valley branch of the Louisville & Nashville railroad. The engine was running as an extra, and had the wrecking outfit. The morning was very foggy in the mountains, and the engineer, J. Means, could see but a short distance ahead.

When near Artemus, a small station twelve miles from Pineville, a red flag was discovered on the track. The train was so close upon the flag before it was possible to see it that they could not stop before the engine struck a push car belonging to Section Foreman Cummings. No damage was done, but Cummings got very angry and undertook to tell Engineer Means and Fireman Harry Geer what he thought of such work. One angry word followed another, and Cummings sent one of his colored laborers after his Winchester. The negro soon returned with the gun and handed it to Cummings, who at once "pulled down" on Engineer Means, who made a quick jump and struck the irate section foreman full in the face before he could shoot, causing him to drop the gun and defend himself as best he could. Means had decidedly the best of the fight, and the negro picked up the gun to shoot Means. Brakeman Traynor promptly knocked the negro down a bank, and with the Winchester he fired three shots at him without effect. The extra then pulled out, but Cummings said he would kill Means if it took him twenty years.

On the return trip, in the evening, as engine 108 passed the same place, a bullet crashed through the cab, barely missing Engineer Means, and Cummings was seen standing on the bank with his gun.

At 11 o'clock the next morning the same engine returned to Pineville, again found a red flag at the same spot, and came to a full stop. Cummings was seen standing on the bank with his Winchester rifle, and the crew of the train naturally decided he wanted to shoot them, and they fired at him. Cummings fell at the first fire, and on examination was found to have been hit in five places. A 44-caliber ball struck him in the thigh; a 32-caliber struck him in the face, and a buck-shot pierced his leg. Strange to say, the attending physician says he will recover with careful nursing. Conductor Maupin, Engineer Means, Fireman Geer, Brakemen Traynor, Cooper and Cunningham gave themselves up on arrival of their train at Pineville, and were brought to Barboursville yesterday morning for trial. They are charged with shooting with intent to kill.

As going to show that the story is not altogether improbable, we relate the following, which we know to be a fact: In this same State of Kentucky, some few years ago, a cow was killed on the railroad, and the incident was duly reported by the engine-driver to the company. The owner of the cow waited for the next arrival of the cow-killing engine and demanded the price of the animal. The engine-driver said: "Oh! that's all right; the company will pay as soon as it gets around to it." To which says the Kentuckian: "Look a-hyar, stranger, I don't know the company, but *you* killed that cow, and I will call around to-morrow again, and if you don't pay for that cow, I'll fill you full of holes. Do you hear me?" The cow was paid for, under protest.

CORRESPONDENCE.

A Correction.

TO THE EDITOR ENGINEERING NEWS,

SIR: I beg to call your attention to a mis-statement on page 515 of your last week's issue, in which you quote my remarks at the Chicago Convention relating to some experiments with jets. There was a mistake in the official report, therefore you are not responsible for it.

The third line should read, "would consume 1,224,000" instead of "12,240,000." The next line should read "1,000 ¼-in. streams" instead of "a ¾-in. stream." The next line, "1,000 ¼-in. streams" instead of "a ¼-in. stream."

J. A. TILDEN.
Supt Hersey Meter Co.

The Cape Hatteras Light.

OFFICE OF U. S. LIGHTHOUSE ENGINEER,
TOMPKINSVILLE, N. Y., May 31, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have just read and heartily approve your editorial in to-day's issue on the Hatteras Light Contract.

In "Ancient and Modern Lighthouses," published by Tickner & Co., I describe how Fourteen Foot Bank Lighthouse was built, and suggest a method of construction for the foundation of Cape Hatteras Light.

This method requires a caisson; but since writing the book it has occurred to me that an artificial island of riprap, with a core strengthened by concrete, would make a stable foundation, and that its construction would be attended with much less risk of loss.

D. P. HEAP, Maj. U. S. Eng's.

[In our issue of Oct. 31, 1885, interested readers will find an illustrated description of the 14 Ft. Bank Light-house referred to by Major HEAP.—ED. ENG. NEWS.]

The Elyria Arch—Correction.

BALTIMORE, Md., June 2, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your description (May 31, 1890) of the beautiful stone arch bridge at Elyria, O., I note the following dimensions given: Span = 150 ft.; rise, 27 ft.; radius, 208⅛ ft.; key, 3 ft. 9 ins.

In calling attention to the boldness of the construction, the disparity between the actual key and the key calculated by TRAUTWINE'S rule is especially referred to. If the span and rise are correctly given in the description, and the bridge is a segmental circular arch, as the illustration shows, then the radius is incorrectly stated, as is also the depth of the key by TRAUTWINE'S rule.

Assuming the span and rise to be as stated, the radius would be 117⅝ ft., instead of 208⅛, as given, and the key, by TRAUTWINE'S rule, would be 3 ft. 8 ins., or by RANKINE'S rule 3 ft. 9 in., showing the designer of the bridge to have been following the old authorities.

J. B. B., P. A. Engr., B. B. R. R.

[The correction is a just one, and the error is our own, due to the misplacement of a figure.—ED. ENG. NEWS.]

Who First Used the Air-tight Fireroom and Forced Draft on Steamships?

OFFICE OF CHAS. H. HASWELL,
M. Am. Soc. C. E., Ins'n C. E., etc., etc.,
NEW YORK, May 28, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

Inasmuch as the operation and results of a close or air-tight fireroom are approved of, and it is being very generally introduced in steamers of foreign construction, and as on a late and previous occasions, claims to the priority of its design have been advanced by some English engineers, I, being fully advised as to the first introduction of it in this country, and having personally directed its application a few years later (1845) in one of our steam frigates, I advised Mr. FRANCIS B. STEVENS of the claims that were presented, and in response I received the reply given below.

In this connection and in support of the above claim I further submit I am also personally cognizant of the introduction of the fan blast to the furnaces of the steamboat *North America* (1827) and the exhaust blast to the base of the chimney of the steamboat *Passaic* (1836).

Respectfully, CHAS. H. HASWELL.

HOBOKEN, N. J., May 21, 1890.

Mr. CHAS. H. HASWELL:

DEAR SIR:—I have received your letter of the 19th inst. The date of your previous letter is May 9, and in it without mentioning any publication, you say: THORNEYCROFT in a late article before the Institute of Civil Engineers of England, claims that his father is entitled to the credit of first using or introducing a fireroom blast in 1855."

You will find the reference to the date that I spoke of in relation to the use of the fan blast on the steamboat *North America*, in the American edition of Wood's treatise on railroads, in a foot note to page 330, Carey & Lea, Philadelphia, 1832.

The fan blast was applied to the steamboat *Passaic*, when she was built in 1836. It was placed at the base of the chimney, having a vertical spindle and acting by exhaustion. The fan of the steamboat *Old Philadelphia*, was also placed at the base of the chimney, and also acted by exhausting the air from the furnace, but its spindle was horizontal. This was done in 1838. But in the following year the blast was altered so as to be delivered in the closed ash pit.

Yours very truly,
FRANCIS B. STEVENS.
HOBOKEN, N. J., May 17, 1890.

MR. CHAS. H. HASWELL:

DEAR SIR:—I have received your letter about the fan blast, and enclose an official copy of the patent for it granted to the late Mr. EDWIN A. STEVENS. It is dated April 1, 1842, and numbered 2,524.

Mr. STEVENS in the spring of the same year applied his invention to the steamboat *Rainbow*, then plying on the Delaware between Philadelphia and Wilmington, Del., and afterwards to the steamboats *New Philadelphia*, *Trenton*, *Burlington*, and to many others. On all these vessels the firerooms were made air-tight, with their doors opening inwards, and closing against rubber-strips. The date when you, while Engineer-in-Chief of the U. S. Navy, applied this fireroom blast to the frigate *Mississippi* was July 1845.

The rotary fan for forced draught for steam boilers has now been in use in this country for upward of sixty years.

Although the project of employing bellows or blowers to steam boilers was broached by the famous Dr. DENYS PAPIN about two centuries ago, yet, as far as I am aware, the first application of the fan blast to a steam boiler was made by the late ROBERT L. STEVENS, the elder brother of EDWIN A. STEVENS in the year 1827 on the boilers of the steamboat *North America*, thus antedating by two years its application by Ericsson on the locomotive *Novelty*, at the trial on the Manchester & Liverpool Ry., in 1829.

The fan blast was applied to the *North America's* boilers under the grate, with the ash-pit doors closed; and, as it was perfectly successful from the start, it was used continuously on that vessel, and was soon afterward adopted on the Hudson River and on Long Island Sound. A reference to this application of the fan blast on the *North America* will be found in a footnote to page 336 of the American edition of "Wood's Treatise on Railroads," published by Carey & Lea, Philadelphia, 1832.

In the year 1836 Mr. R. L. STEVENS applied an exhaust fan blast with a vertical spindle placed at the base of the chimney on the steamboat *Passaic* in the harbor of New York.

In the latter part of the year 1837 and early in 1838, the two brothers mentioned applied an exhaust fan blast with a horizontal spindle, to the shop engine of the Camden & Amboy R. R., at Bordentown, N. J., and then with the aid of this blast made a series of experiments on the comparative power of anthracite coal, bituminous coal and wood, commencing Feb. 7, 1883, and ending June 3. In the same year they placed an exhaust fan blast on the steamboat *Philadelphia*, then plying on the Delaware; but as the exhaust fan blast was found to require about twice the speed of one that delivered under the grate, the use of the former was discontinued. On the steamboat *Rainbow*, above mentioned, a blast of four or five inches of water pressure was originally delivered, in 1841, under the grate, and as this was found to be too great a pressure for the firemen, the fan was removed and applied at the base of the chimney, so as to act by exhausting. But although the fan was driven at a far greater speed it was much less efficient.

Within fifteen or twenty years after the introduction of forced draught in 1827, it was used on the majority of the steamboats navigating the rivers and bays on the Atlantic seaboard, and when it was found how greatly the fan could increase the power of the boiler, and consequently that of the engine, it was frequently driven so as to treble the power. At that period, on the Hudson River, the humming noise of the blower could be heard for several miles, while at night a long trailing flame was seen to issue from the chimneys. And the blast pressure carried would frequently force the gases of combustion, in the shape of a serrated flame, from the joint around the furnace doors, in so great a quantity as to affect both the efficiency and the health of the firemen.

It was at this period that Mr. E. A. STEVENS invented the air-tight fireroom and applied it the steamboat *Rainbow*.

The mere efficiency of the fireroom blast, apart from all other considerations, was thoroughly tried in the year 1846 on the steamboat *John Stevens*, while indicating 1,840 horse-power; and again the same test was made in the year 1850 on the steamboat *John Neilson*, while indicating 2,020 horse-power. And it was found in both cases that when proper precautions were taken there was no difference in efficiency between the two methods. At the trial of the latter vessel upward of eighty pounds of coal were burned per square foot of grate surface per hour for three consecutive hours by each method.

To lessen the waste of fuel and the repairs of the boilers, and also the cost of maintaining the blowers driven at an excessive speed, the pressure of forced draught has been gradually reduced when used on the vessels navigating the rivers and bays of the Atlantic seaboard, to a maximum water pressure of between one and two inches.

During the last 10 or 15 years forced draught has been gradually introduced on vessels of war, and its advantages in doubling, or in some cases in more than quadrupling the power, have been so universally recognized, that the fan blower and the air-tight fireroom are now in use in the navies of all nations.

You are at liberty to publish this letter; but I wish to state that I have not written it to detract from or underrate the great engineering achievements of the THORNEYCROFTS.

Yours very truly,
FRANCIS B. STEVENS.

An Extraordinary Correspondence.

PITTSBURG, May 17, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The following correspondence requires little, if any, comment from us. We present it for publication as the most direct method of throwing some light on the statements made at the meeting of the New England Railroad Club, March 12 last, noticed in your issue of March 22 and May 3, on the subject of breakages of "M. C. B." or "Janney Type" couplers.

A single fact will serve to indicate the spirit which must have prompted the statements made at that meeting.

On Nov. 21, 1889, there were shipped to the Boston & Albany R. R., care of F. D. ADAMS, Allston, Mass., 12 Janney knuckles, presumably for repairs. On April 24, 1890, there still remained in the repair shed at Allston (counted by the writer) *five* knuckles out of the *twelve* referred to above, so that in a period of five months. Mr. ADAMS, who reports an average breakage of 119 knuckles per month (595 for five months) maintained repairs on that enormous basis with seven knuckles.

Respectfully, WM. MCCONWAY,
President McConway & Torley Company.

[The correspondence enclosed is as follows. As Mr. MCCONWAY states, it tells its own story.—ED. ENG. NEWS.]

PITTSBURG, Pa., March 15, 1890.

F. D. ADAMS, Esq., M. C. B.,
Boston & Albany R. R., Allston, Mass.:

DEAR SIR: The inclosed clipping has been sent to us by a correspondent who does not give us the name of the newspaper from which it is taken. We are very much interested in the paragraph which we have marked with a blue pencil on the clipping, in which you are quoted as saying: "In 60 days, this last season, 347 broken Janney couplers were reported on his (your) road, and it is considered an enormous breakage considering the total number of Janney couplers that were run over the road during that time."

The number of breakages, if the same applies to the *Janney* coupler, is so extraordinary that it would require our especial attention, but we do not care to institute an investigation until we can assure ourselves that you have been correctly reported. Will you kindly advise me if this is the case?

Very respectfully, WM. M. CONWAY, Prest.

ALLSTON, Mass., March 18, 1890.

MCCONWAY & TORLEY CO.

GENT: In answer to yours of the 15th, in regard to my statement that we had broken in 60 days 347 Janney couplers—I did not say we had broken so many Janney couplers, but that we had broken on our road in 60 days 347 couplers of the Janney type, and I say it again. The record was carefully taken and this was the report. I say this is an enormous breakage considering the small number of cars that came to us equipped with this type of coupler. Yours, F. D. ADAMS.

Mr. MCCONWAY to Mr. ADAMS.

PITTSBURG, Pa., March 26, 1890

DEAR SIR:—I beg to acknowledge receipt of yours of the 18th inst., which has been duly considered. I found from the report of the meeting of the New England Railroad Club, as published in the technical papers, that you had been misquoted in the newspaper the clipping from which I sent you.

I quite agree with you that a breakage of 347 couplers in 60 days is an enormous one, considering the small number of cars that you receive which are equipped with the Janney type of coupler. The point, however, which interests us most in connection with this subject, is not to ascertain how many couplers of the Janney *type* were broken, but how many *Janney couplers* were broken and included in the 337. * * * we hold ourselves responsible within the limits already explained in our letters of Oct. 20 and March 15, for any breakages of the Janney coupler and we will be therefore under obligations to you if you will call out from your reports the number of Janney couplers included therein. If your report will enable you to indicate the character of the breakages, on the blanks which we enclose herewith, you will add to the obligation under which you will place us by sketching each breakage for our use.

We have no reason to expect a very heavy return of breakages from your line, as we find that the total amount

of materials furnished you. upon requisitions for repairs of Janney couplers, is only 12 knuckles.

In addition to the favor which we ask above, we again beg that you will accept our proposition of Oct. 20, 1889, at which time we wrote you: "If you have any broken Janney freight couplers or wrought iron knuckles in your scrap heap we should be very glad to have you avail yourself of the foregoing proposition and send them to us for test and replacement as proposed." Very respectfully,

WM. MCCONWAY, Prest.

ALLSTON, Mass., March 28, 1890.

THE MCCONWAY & TORLEY CO.

GENT: I do not wish to continue any controversy or correspondence in regard to the question as we should never agree consequently I prefer to let this be the end of it. I will say to you that in the record of breakage we find of the Janney 58 bars broken and besides these, 238 knuckles broken. The fact that you are not notified is no proof that hundreds of your knuckles are [not] broken on roads that have no correspondence with you in regard to it. I have no doubt others do as we do make a pattern, and get them made at some place where steel castings are made—this is what we do—so that the record that is published in the ENGINEERING NEWS and other railway papers are not worth anything only to mislead the managers of roads. Yours, F. D. ADAMS.

PITTSBURG, Pa., May 10, 1890.

F. D. ADAMS, Esq.,
M. C. B., Boston & Albany R. R.,
Allston, Mass.

DEAR SIR: Upon receipt of yours of March 28, in reply to ours of 26, we set about making an investigation for the purpose of determining the nature of the foundation upon which were based the statements concerning breakages of Janney couplers, contained in the paper which you read before the New England Railroad Club, at the March meeting.

The statements made in that paper can be construed only to mean, that on the Boston & Albany R. R. you had actually broken 296 Janney couplers and knuckles in the ordinary course of handling cars, and incidentally, that these cars had been delivered to the Boston & Albany R. R. in good order.

Since the publication of that paper the writer has made a personal investigation on the line of the Boston & Albany R. R. with a view to getting by observation, if possible, the information which you declined to give. The facts as they appear to him are: that you have caused a record to be taken of the *condition* of couplers on cars passing over your road during a period of two months, that this record notes defects of any character whatever, as for instance a crack or a chip out of a coupler or knuckle; that this cracking or chipping did not necessarily occur on your line, nor did it in any way disable the coupler or render it unsafe; and further, that few, if any, of the breakages or defects were repaired by you, your company not being responsible for them because not actually causing the damage.

You have published widely a statement that was meant to convey to those who read it, that the number of Janney couplers specified in that report was actually broken by your employés on the line of your road and, by implication, that your company was put to the expense of that number of renewals.

It is our purpose to publish, equally as widely, the true facts, as they seem to us, but, as that publication will necessarily call into question your good faith and veracity, we deem it but just that you be notified of our intention, to the end that you may have opportunity to deny the correctness of our conclusions, before that publication.

In conclusion, with reference further to your letter of March 28, we beg to remind you that you cannot make a public statement affecting private interests, as you did at the March meeting, and successfully dismiss the further consideration of the subject by a captious declaration that "you do not wish to continue the controversy."

Yours respectfully, WM. M. CONWAY, Prest.

[Up to the present time (June 5), or 26 days after this letter was mailed, no reply has been received from Mr. ADAMS. The paper read by him, which was, nominally at least, by Mr. JOHN M. FORD, a clerk in Mr. ADAMS' office, stated in so many words that in two months there had been 296 fractures of Janney couplers (a statement which Mr. ADAMS repeats above, itemizing it as 58 bars and 238 knuckles), and that the cost for maintenance due to these breakages and to 51 breakages of other couplers had been $13 each for couplers and $4.20 each for knuckles, in these two months a total of $2,038.20, an average per fracture of $6.80. The total cost new of the parts alleged to be fractured is for the Janney $8.50 for couplers and $4 for knuckles, but in addition two broken knuckles are exchangeable for one sound one, and all couplers failing from original defect (amounting in general experience to about two-thirds of such failures) are also exchangeable for sound ones without charge. Making these corrections and assuming that the broken parts of other makes are renewable on substantially the same terms as the Janney, the total cost for these renewals would have been:

66 couplers @ $2.83	$186.78
281 knuckles @ $2	562.00
Total for new parts	$748.78
Leaving as the apparent allowance for labor in applying	$1,289.42

It is needless to say that this is far too large an allowance, even assuming all these parts were actually renewed; but the question remaining unanswered is: Do these alleged breakages represent any *actual renewals*, and if so, how many? The implication of the original paper was as distinct as language could well make it, that each and every reported breakage represented an actual renewal.—ED ENG. NEWS.]

Gone Down Salt River.

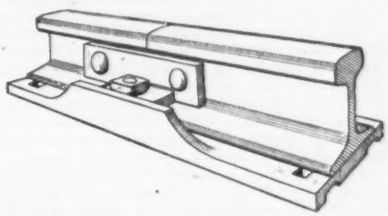
The accompanying cut almost speaks for itself, without much explanation from us, nor are we able to give much. It is the old story of a bridge laid out high and dry above low water, but with so little allowance for possible high water that the first serious flood carried part of it away, and greatly endangered all the rest. The cause of the destruction of the trestle in the foreground was plainly that the water rose high enough to strike the floor. The truss in the back ground barely escaped the same fate.

The very name of the river might have suggested more caution, but the designer possibly forgot the fact that it was as bad to go down Salt River as up it, and laid his grade a little too low. The instances in which the same misfortune has happened to other bridges are numbered by thousands, and nearly always from the fact that the lamb-like look of streams at low water makes it difficult to understand what raging torrents they will become at high water. Our engraving hardly does justice to the great violence of the current, and its much greater speed through the break as compared with that under the truss and trestle.

Gone Down Salt River.—Wreck of a Trestle Approach on the Phoenix & Maricopa R. R. over Salt River, Arizona.

Fisher Joint with Fish Plate Connection.

The objection most frequently and earnestly urged against the Fisher joint, perhaps, is that it does not hold the rails precisely in line laterally. The inventor has never admitted that this is a valid objection, nor are we able to see that it is one of very great weight. At any rate, the end of all ends sought is to keep the rails in perfect surface, rather than in perfect line, and to this end the Fisher joint seems better adapted than any angle bar joint. To illustrate how easily this alleged objection can be overcome, however, Mr. FISHER sends us a model from which the accompanying engraving has been prepared, which shows the fish plate principle applied to the joint without affecting in any way its essential character. It will be seen that the rail heads are held absolutely in line, while yet no bearing is provided under the head to give chance for the usual irregular fish-plate wear. We understand that Mr. FISHER is prepared to furnish joints of this character to anyone who prefers them, at a nominal addition in cost, although he does not himself recommend them. Further information can be had by addressing the Fisher Rail Joint Works, Trenton, N. J.



Fisher Joint with Fish Plate Connection.

The Iron and Steel Institute Meeting.

FROM OUR LONDON CORRESPONDENT.

The recent annual London meeting of the British Iron and Steel Institute possesses more than usual interest for American metallurgists and engineers, from the fact that the Autumn meeting of 1890 is to be held in New York. Last year the Institute journeyed to Paris, where a highly satisfactory meeting was held; and, emboldened by this success, members are looking forward to their coming more adventurous flight with the most lively anticipations of pleasure, anticipations which are fully justified by the generous invitation that has come across the ocean at the time of this spring meeting in England.

The members of the Institute assembled in the theatre of the Institution of Civil Engineers, the council of the latter body having extended their invariable hospitality to the kindred society, on May 7, the meeting extending over the following day. The President, Sir JAS. KITSON, was in the chair, and there was a good list of papers for discussion. We give the following list in order that those most interested in any of the subjects named may know to what source they may refer for information, for manifestly but a mere outline can be given in a notice such as this:

"A New Form of Siemens Furnace, arranged to Recover Waste Gases as well as Waste Heat." By JOHN HEAD, London, and P. POUFF, Nevers.

"Calculations Concerning the Possibility of Regenerating the Gas in the New Siemens Furnace." By Prof. AKERMAN, Stockholm.

"The Critical Points of Iron and Steel." By F. OSMOND, Paris.

"The Carburization of Iron by the Diamond." By Prof. W. C. ROBERTS-AUSTEN, F.R.S., London.

"The Changes in Iron Produced by Thermal Treatment." By E. J. BALL, Ph.D., London.

"The Robert-Bessemer Steel Process." By F. LYNWOOD GARRISON, Philadelphia.

"Aluminum in Carburetted Iron." By W. J. KEEP, Detroit, Mich.

"Certain Chemical Phenomena in the Manufacture of Steel." By W. GALBRAITH, Chesterfield.

"The Estimation of Phosphorus in the Basic Siemens Steel Bath." By W. GALBRAITH, Chesterfield.

"The Rollet Process for Purified Castings." By A. ROLLET, St. Etienne, France.

It will be seen from this list that six out of the ten papers read were contributed from foreign sources; a fact upon which the Institute is much to be congratulated, not only because the wider the field from which information is gleaned the more rich is likely to be the store of knowledge, but also from the fact that it shows the wide-spread influence of the society. Mr. KEEP's paper undoubtedly raised the most interesting discussion, and it was much regretted that the author was not present to reply to the points raised. Possibly, however, there may be an opportunity of re-opening this important question when the joint meeting of the American Institute of Mining Engineers and the British Iron and Steel Institute is held next Autumn in New York; on which occasion, it may be added several leading metallurgists of the European continent are expected to be present.

In all this pleasant anticipation for the coming Autumn there is, however, one note of regret for the members of the Iron and Steel Institute, and judging from what we in England know of American metallurgists, more especially after listening to Mr. HEWITT last year, this regret will be as fully shared by the hosts as by the guests at the coming meeting. We are naturally proud of the man who is the father of the modern steel trade, but unfortunately, although Sir HENRY BESSEMER has taught us how to control the elements in the converter, he is himself entirely controlled by the elements upon the ocean. In short, Sir HENRY, like some other great Englishmen who have preceded him—notably, Admiral NELSON—"has a poor stomach for the sea;" otherwise, the Iron and Steel Institute would not journey to the United States without its chiefest member.

We must, however, leave our anticipations for the future, and deal with the past meeting. The papers were taken in the order in which they are given above; the first being that of Messrs. HEAD and POUFF.

A NEW REGENERATIVE FURNACE.

The form of Siemen's furnace referred to in the title was illustrated by cartoons hung on the walls of the theatre. Without the aid of these illustrations it would be difficult to give an idea of the form of the furnace, but the general principle upon which it is designed may be described as follows. In an ordinary gas producer carbonic acid is formed on the grate, and this is converted into carbonic oxide by being passed through incandescent fuel in the upper portion of the producer. This carbonic oxide mixed with other gases distilled from the coal supplies the source of heat for the furnace. The production of the carbonic acid is attended with the development of heat, but its conversion into carbonic oxide absorbs heat. These facts are, of course, well known, but it is well to repeat them here as they bear on the process about to be described. When the gases have been burnt in the heating chamber of the new Siemens furnace, a portion of the products of combustion are taken to below the grate of the gas producer, and as a large part consists of intensely heated carbonic acid (together with nitrogen and water in the gaseous state), the production of carbonic acid in the producer may be dispensed with. The idea is ingenious, although at first sight it would seem as if an effort was being made to *create* heat. No such impossible task, however, is being attempted. All that is done is to catch the waste heat of the furnace gases and utilize it for gasifying the fuel in the upper zone of the producer. In the ordinary Siemens furnace, of course the heat of the products of combustion is not wasted, but is arrested by the chequer work of the regenerators, and in the new furnace there are air generators, too. It became a question, therefore, whether there would be sufficient heat in the products of combustion from the furnace to convert the fuel into carbonic oxide and to heat the regenerator. This question has been answered in the affirmative in the course of a year's regular working. The new furnace has been applied for heating and welding iron, for copper and steel melting, and for puddling, with success. It is said by the authors of the paper to effect a saving in fuel of two-thirds the weight, as compared with ordinary solid fuel furnaces; or, if allowance be made for using the waste gases for raising steam, 560 lbs. of coal per ton of iron heated; and there is a reduction in the waste of iron equal to 5%. There is also said to be a saving in labor and repairs.

In the discussion which followed the reading of the paper the invention may be said on the whole to have been commented upon favorably.

Professor AKERMAN's paper was an elaborate examination of the theoretical aspect of the new furnace. Such speculations are, however, to a great extent robbed of their practical value by the small and uncertain knowledge we possess upon the specific heat of gases at high temperature.

ALUMINUM IN STEEL.

The next paper we shall notice is that of Mr. W. J. KEEP; not that we intend abstracting the paper itself, for his researches are at least as well known in America as in England; and, we believe, the information now placed upon the transactions of the Iron and Steel Institute has already been communicated to American societies. It may be interesting, however, to hear the opinion of practical steel makers in this country who have tried aluminum as an alloy for iron; a question which has occupied the attention of metallurgists over here more than any other since the subject was first brought within the range of practical procedure by the cheaper methods of producing this useful alloy. The first speaker was Mr. JAMES RILEY, the manager of the Steel Company, of Scotland, and one of our most successful steel makers. Mr. RILEY said he had been much pressed to use aluminum in steel making. His main object had been, in adopting the alloy, to lower the melting point, so as to be able to make complicated castings with greater facility. Aluminum had undoubtedly effected this, and in cases where a considerable percentage had been added the fluidity had been increased, but at the time the cooling during pouring had had the effect of causing the metal to set quickly, and only half the metal at times could be poured out of the ladle; in addition to which the metal had been short and crystalline. This was in extreme cases, however. With more moderate percentages the tensile strength was raised slightly, perhaps two or three tons, but there was not more improvement in this respect than often appeared when comparing different casts of ordinary steel. The elastic limit was raised considerably, and there was also an addition to the quality of ductility. Taking all these points into consideration, however, Mr. RILEY had come to the conclusion that the additional cost of the aluminum was not warranted by the advantages gained, and he had given up the use a year before. But the price of the alloy had since been reduced and he was induced to make another trial, but his present impression was that the use of aluminum in steel would only be advisable when fine thin castings are required.

Mr. SPENCER, of the Newburn Steel Works, Newcastle-on-Tyne, another experienced and successful steel maker, said he should have said much the same as Mr. RILEY, had not the latter spoken first. He would only add that there was a great deal in the application of aluminum. It would not be advisable for all kinds of steel alike. For low carbon it answered better, but for the higher grades it would not come up to the anticipations that were formed for it. Other speakers pointed out that it was not judicious to form an estimate upon the value of aluminum by judging simply by the quantity put into the bath, as it was an alloy likely to disappear through chemical reaction during the process of manufacture; for instance, it might be removed if carbonic oxide were blown through the steel. For this reason analyses should be made to see if the aluminum was present in the finished metal.

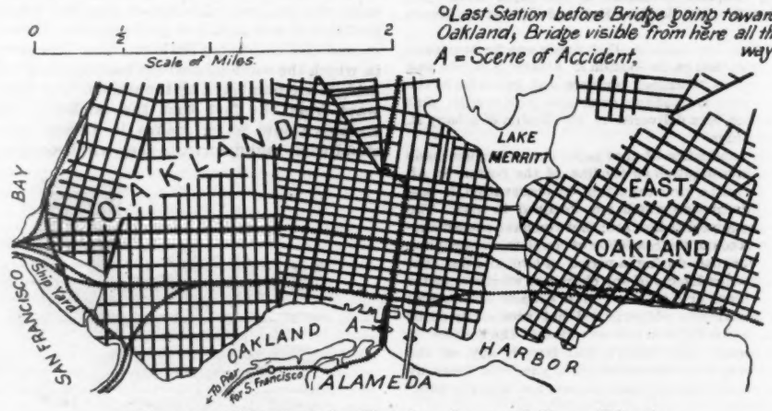
Mr. GALBRAITH's two papers did not bring forth much that calls for detailed notice here, although they were carefully thought out productions. Mr. ROLLET's contribution described a form of cupola in which the slag and metal (pig-iron for steel making) were separated immediately on flowing from the tap hole, so as to prevent the re-absorption of phosphorus from the slag by the iron, and also too great a recarburization of the metal. A similar arrangement has been in use in England at the Clarence Iron Works of Bell Bros. & Co.

The Oakland, Cal., Draw Disaster.

The accompanying sketch map, sent us by a valued San Francisco subscriber, who personally looked up the facts for us, Prof. WM. G. RAYMOND, of the University of California, shows the scene of what is certainly, in every sense, the worst accident of the week; and almost, if not quite, the worst draw disaster since the famous one at Norwalk, Conn., in 1853. By that disaster 46 persons lost their lives, the accident having much more excuse than this last one, however, as the draw was approached by a sharp curve, instead of being in plain sight for a long distance. By a curious coincidence, the engineman of that train also was a Californian.

The circumstances of the Oakland disaster were as follows: The accident happened to a local train connecting at Oakland with the ferry boats from San Francisco. The draw at the point shown on the map had been opened to let a yacht through. There had been no unusual delay, and the draw-keeper was in the act of closing it, and had it more than half closed, when the engine, tender and first car plunged into the gap, at somewhat reduced but still pretty high speed. The coupling broke behind the first car, and the two rear cars escaped immersion, but the front end of the second car was almost wholly torn away, and several passengers fell from it into the water. The total number of passengers on the first car was about 30, of whom 13 lost their lives, and possibly two others, while several were severely injured.

I would have wired you, but it was too late for your issue of May 31, or, at least, I supposed it was, my information not being in shape till 7 P. M. Pacific time. The draw span is an iron railroad and wagon bridge; three trusses; ordinary form parallel chords; turned by hand. The approaches are a series of short span wooden Howe pony trusses, resting on piles. The diagram inclosed gives a good idea of the situation. The road is the South Pacific Coast, owned by the Southern Pacific Co., and is narrow gauge. It is (or was) the custom to approach and cross the bridge at a high rate of speed. The bridge is in full view from last station on the Alameda side of the creek to the bridge. There was no fog. The accident is absolutely inexcusable. I rather think the statement in the *Chronicle*, to the effect that the engineer ran his train straight ahead, knowing the draw to be open, but expecting it to be closed by the time he got there, till he had



Map of Oakland, Cal., Showing Scene of Draw Disaster.

gone too far to stop, is correct. I can conceive of the engineer—careless from long experience—being in that state of mind; and I cannot conceive of his deliberately running into an open draw that both he and his fireman could see for three quarters of a mile or thereabouts.

We can add little to the summary of the main facts thus given. As in the Norwalk accident, there was some dispute as to whether the usual red signal for "draw open" was displayed or not; but it is no longer necessary to rely on such merely manual signals, as it was at Norwalk, there being plenty of automatic signals which must be first displayed to open the draw. In not having them, or, in default of them, in not requiring a full stop before the draw, the company is plainly blameworthy, and the jury has so found; but the fact that the bridge was in plain sight for three-quarters of a mile before it was reached would certainly excuse, if anything could, some slackness in this respect; and the engineman must certainly have been a phenomenally careless or absent-minded man. The coroner's jury found him guilty of manslaughter; but even if he be tried, convicted, sentenced and imprisoned, it will not bring the dead to life again, and therefore the incident furnishes another strong argument in favor of requiring the use of interlocking signals and derailing switches at all such points.

Street Traffic in Towns.

In alluding to the unceasing expansion of Berlin, and the consequent increase of traffic in the main thoroughfares, to the great inconvenience of the public, *Kuhlow's German Trade Review* says a project has just been evolved at Munich which deserves more than a passing reference. Should the plan of Mr. ROSENBUSCH—for that is the name of the inventor—be carried out, our streets and houses will undergo a total transformation.

Mr. ROSENBUSCH proposes to entirely do away with cellars below the level of the street, which, as he justly observes, from their defective light and air are very hotbeds of disease, and to construct on the site a passage the floor of which would be on a level with the street. Instead of finishing on a line with the houses above, the passage would extend to the gutter, so that the road would be bounded on both sides by these passages. The sidewalk would be erected above the passage, and the former, in the form of a gallery, would be completely isolated from the vehicular traffic in the roadway below. A balustrade would prevent people walking on the sidewalk from falling into the roadway, whilst the shops would be at the other side of the sidewalk. From the coign of vantage thus afforded the pedestrian could gaze with the most perfect security at the busy scene below. His serenity would be troubled by no drainage works, or the laying of gas or water pipes, or of telegraph, telephone or electric wires, for all that would take place in the roadway.

The latter—and herein consists one of the great advantages claimed from Mr. ROSENBUSCH'S scheme—would be more completely available than at present for all vehicular purposes. Electrical and steam tramways could attain a much greater speed, as the foot passenger consideration would then be reduced to a minimum. The steps leading from the sidewalk to the street seem to be one of the weak parts of the scheme, for it may be expected that the number of broken legs and arms caused by the slippery state of the steps in winter would outweigh the accidents at present arising from vehicles. Perhaps some new city in the Far West of the United States will give Mr. ROSENBUSCH'S scheme a trial.—*London Architect.*

THE SAULT STE. MARIE CANAL did its biggest day's business on May 26, when Genl. Supt. WHEELER reports a tonnage, registered and freight, of 74,686 tons passing through the lock. The passages for the day numbered 72, and exceeds the tonnage of July 19, 1889, the heaviest previous day's business, by 6,369 tons.

THE NEW YORK WATER FAMINE is assuming serious proportions, and many down-town localities cannot obtain water, even on the ground-floor, between 6 A. M. and 6 P. M. The Central Park Reservoir is lower by 4 ft. than at the same date last year. Chief Engineer FTELEY, of the New Croton Aqueduct, reports that, while there is still considerable work to be done on the line, he believed that if a large force was put on water could be led to the Park Reservoir by July 10. When the reservoir had been filled the water could be shut off and the work completed in about six weeks. Chief Engineer BIRDSALL reported the present consumption of water as equal to 96,000,000 galls. per diem from the Croton Aqueduct and 18,000,000 galls. from the Bronx, 114,000,000 galls. in total. We should have 50,000,000 galls. per day additional.

BROOKLYN BRIDGE ANNUAL RECEIPTS, since the opening, are thus given by Bridge Superintendent C. C. MARTIN:

TOTAL RECEIPTS FROM MAY 23, 1883, TO JUNE 1, 1890.

Years.	Total receipts from tolls.	Increase of tolls.	Per cent. of increase.
First	$482,938 00	....	....
Second	565,344.46	$162,406.46	42.1
Third	680,466.87	115,122.41	20.4
Fourth	809,207.98	128,741.11	19 0
Fifth	886,180.03	76,972.05	9 5
Sixth	965,052.11	78,872.08	8.9
Seventh	1,078,847.03	113,784.92	11.8
Total	$5,388,036.48		

The railroad fare was reduced to 3 cents, March 1, 1885. Promenade tickets, 25 for 5 cents, Feb. 1, 1885.

THE NEW YORK STREET-CLEANING PLAN introduced by Commissioner BEATTIE has worked well on its first limited test. This is to make two men personally responsible for the cleanliness of two blocks and the side streets half way to the next street. These men are provided with a patent ash can secured to a barrow, two brooms and a scoop shovel. Only 20 men have been so employed, but the plan is to be extended.

THE ORANGE, N. J., SEWERAGE, and its proposed disposal into the Passaic River, is the subject of controversy between the Orange officials and the Newark Aqueduct Board. The Aqueduct Board had instructed its counsel to take all necessary steps to prevent Orange from emptying its sewage into the Passaic. But the Orange authorities have gone on with their plans, as lately outlined in this journal, and are practically ready to let contracts. As the city of Passaic is enjoined by the Newark Board in the same manner, Orange officials have been visiting Passaic to see what that city is doing in the matter. Passaic has gone on with her sewers in defiance of Newark, and the first decision, by Chancellor MCGILL, has been in favor of Passaic. The case is now before the Court of Errors and Appeals, and a decision is expected any day. If this is against Passaic a chemical process will be adopted. Orange awaits this decision, and may have to do the same.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Delaware, Lackawanna & Western.—Wm. Unruh, of Hoboken, N. J., Chief Engineer, writes us as follows:

About 250 men and 75 teams are now at work on the extension of the Passaic & Delaware Extension R. R. from Bernardsville to Peapack, N. J. The length of the line is 7½ miles, and of this distance about 1¾ miles have been graded. The work is light; maximum curve, 5¼°, and maximum grade, 60 ft. per mile. Rusling & Fagan are the contractors. Tracklaying will begin about July 1.

Cleveland, Cincinnati, Chicago & St. Louis.—A press dispatch from Columbus, Ind., says:

The recent deal, by which the Louisville, New Albany & Chicago R. was secured to the Pennsylvania Co., shutting off all competition between Louisville and Chicago has caused the preliminary arrangements to be made for the building of a line from Louisville to Indianapolis, a distance of 110 miles. At a meeting of the new Directory, to be held the first week in June, Morris McDonald, of New Albany, formerly with the Air-line, will, it is thought, be made President of the new road. It is said by parties who know that the C., C., C. & St. L. is behind the enterprise, and that this road will be the Chicago line from Indianapolis. The new line will closely parallel the Jeffersonville, Madison & Indianapolis road the entire distance. Surveys commence the first week in June.

Delaware & Hudson Canal Co.—The bridge over the Ausable Chasm, on the Keeseville, Ausable Chasm & Lake Champlain R. R., has been completed, and the road will soon be opened for traffic. The road runs from Keeseville to Port Kent, N. Y., 5.6 miles, and the tracklaying, with the exception of the portion across the bridge, was completed last year.

Chicago & West Michigan.—Tracklaying has been completed on the line between Baldwin and Traverse City, 75 miles, and a large force is now at work ballasting the roadbed.

Pennsylvania.—It is announced that this company has purchased the franchises and right of way of the West Virginia & Pennsylvania R. R., which is projected to run from Uniontown, Pa., up the Monongahela River to Clarksburg, W. Va. This company has bonded all the properties fronting on the river road south of Belmont Ave., West Manayunk, for the purpose of constructing the new branch that is being built to connect the Schuylkill Valley branch with A. & P. Roberts & Co.'s Pencoyd Iron Works, at Philadelphia, Pa. A large force of men are at work building the new branch, which will pass from the high bridges of the Schuylkill Valley branch, on wooden trestles along the west shore of the river to the towpath or the Reading's Venice branch bridge, where it will run along the river road. The new branch, it is stated, will be completed in about three weeks.

Coudersport & Port Allegheny.—The contract for building the Coudersport & Pine Creek R. R. from Coudersport to Sweden Valley, 5 miles, has been let to W S. Grattan, of Buffalo, N. Y. About 400 men and 30 teams are now at work on the line.

New York, Ontario & Western.—The Board of Directors of this company have authorized the withdrawal from the trustees of sufficient bonds to complete the improvements on the main line and to finish building the new line into the Carbondale coal region. Of the issue of consolidated 5% bonds, $2,100,000 still remain in the hands of the trustees, and it is expected that from $800,000 to $1,000,000 of these will be needed for the improvements. About half of this sum will be used for more equipments and betterments on the main line, and the rest on the new branch, which will be about 3 miles longer than was originally expected. Besides, unlooked for difficulties have been met in the construction of the new road.

American Midland.—This road has been sold to W. C. Dorin, of New York City. It is announced that work will soon begin on the extension from Glandorf, O., west to Ft. Wayne, Ind.

Pittsburg & Western.—The report is again in circulation that this company will combine with the Beech Creek R. R. Co. to form a through line from the west to the seaboard. The scheme necessitates the construction of about 100 miles of new railway.

Ohio & Northwestern.—A press dispatch from Parkersburg, W. Va., says:

"It is reported here that the Norfolk & Western Railroad Co., which is now building an extension of two hundred miles in this State, has secured an option on the Ohio & Northwestern, which runs from Cincinnati to Portsmouth, O., and that the intention is to complete it to a point on the Ohio side, where the extension being built in this state reaches. This would give them a thorough line from Norfolk to Cincinnati.

Projects and Surveys.

Monongahela & Chartiers.—F. C. Renziehausen, of Pittsburg, Pa., writes us that this road is to run from Peter's Creek to North Branch, 14 miles. Surveys are in progress. Henry Large, Jr., is President, and S. Low is Chief Engineer.

Neville Island.—H. C. Christy, of Pittsburg, Pa., writes as follows:

This road is projected to run from Pittsburg, Pa., down the Ohio river to Breno's Island and McKees Rocks, and thence through Neville Island to Coraopolis, a distance of 14 miles. The line has all been located. It is being built to bring to the market a large number of building sites. There will be two 600-ft. and two 400-ft. bridges. The principal business will be the local passenger and freight traffic. The contracts will be let in August or September.

Homer & Susquehanna.—J. M. Guthrie, of Indiana, Pa., writes us that the surveys for this Pennsylvania road commenced on May 28. The object of the road is to develop the coal lands along its route. The road will be about 20 miles long.

Altoona & Wopsononock.—This company has been organized in Pennsylvania to build a railway from Altoona to the Wopsononock summer resort and thence to the coal fields and timber lands. The officers are F. G. Patterson, President; M. A. Green, Vice-President; H. J. Davis, Secretary, and S. J. Westley, Treasurer. The headquarters of the company are at Altoona.

Massillon & Little Beaver.—Chartered in Ohio to build a railway from Massillon to a point in Liverpool Township, Columbiana Co., a distance of about 60 miles.

Port Deposit.—A certificate of incorporation of this company has been filed with the Secretary of State of Maryland. The directors and incorporators are W. Hasell Wilson, of Pennsylvania, President; Jacob Tome, W. J. Thomas, L. Marshall Haines and William C. Culley, of Maryland, and William H. Barnes, and John Harpton Barnes, of Pennsylvania. The capital stock is $300,000. This is the old Port Deposit & Columbia Railroad reorganized.

Phillips & Rangeley.—The contract for constructing this 28-mile narrow gauge railway from Phillips to Rangeley, Me., has been let to D. W. Brown & Bros. The road will cost about $6,000 per mile. By the terms of the agreement Brown Brothers are to build the 28 miles of road complete, including the bridges, the rails, and everything that enters into the construction excepting rolling stock. The road is to be completed to the Redington Land & Lumber Co.'s Mill this year, and to Rangeley before September, 1891. F. E. Timberlake, of Phillips, Me., is Secretary.

Parry Sound Colonization & Railway Co.—The contract for building this road has been let to Wm. G. Reid, Montreal, P. Q. The road, which is 47 miles long, has been surveyed. The grades are low, and the contractor, who is to start the work at once, expects to have 20 miles of it finished by the fall. The road has been subsidised by the governments of Ontario and the Dominion to the amount of $6,200 per mile. The contractor undertakes to have the whole of the work completed inside of two years. The line will open up a rich timber and agricultural country, and it is expected that the traffic from the interior to the fine harbor at Parry Sound will be extensive.

Boston & New York Air Line.—At the annual meeting of this company recently held the following directors were elected: Henry B. Hammond and S. S. Sands, New York; T. D. Watson and W. D. Bishop, Bridgeport; S. F. Loomer, Willimantic; S. E. Baldwin, C. P. Clark and E. H. Trowbridge, New Haven; Theodore Adams, Philadelphia; J. M. Camp and Benjamin Douglas, Middletown. The directors chose these officers: H. B. Hammond, President; T. L. Watson, Secretary, and W. L. Squire, Treasurer.

Plate Run.—Incorporated in Pennsylvania to build a line of railway from the head of Young Women's Creek, in Potter Co., to North Bend, in Clinton Co., a distance of 17 miles. The directors are: Jas. S. Weed, F. M. Weed, Wm. Chill, of Binghamton, N. Y.; Wm. H. Jessup, H. C. Jessup and Geo. S. Jessup, of Montrose, and Horace E. Hand, of Scranton, Pa.

SOUTHERN.—Existing Roads.

Alabama Midland.—It is expected that the grading on the Montgomery, Tuscaloosa & Memphis R. R. will be completed between Montgomery and Maplesville Ala., 49 miles, by June 30. The engineers are now making the profile and estimates on a revised location from Maplesville to Tuscaloosa, Ala., 58 miles. The new location will avoid the construction of a tunnel. Dean, Berry Boehmer & Co., who have the contract, are now subletting the work. C. M. Craig, Montgomery, Ala., is Chief Engineer.

Orange & Keysville.—It is reported that the necessary arrangements have been made for resuming construction on this Virginia railway. Thos. Moore, of 912 East Main St., Richmond, Va., is Chief Engineer.

Georgia Southern & Florida.—This company has promised to begin work on the line from Tifton to Thomasville, Ga., in 90 days, and to have the road completed in 12 months.—The engineers of the Macon & Birmingham R. R. are now locating the line between the Coosa River and Birmingham, Ala. According to the location the road will pass through Roanoke, Talladega and Leeds. Work on the Georgia section is making rapid progress. About 2,000 men are now grading. Thirty miles of the line will be open for traffic in a short time. —Chief Engineer Wm. H. Wells is quoted as saying that

the contracts are practically let for the construction of the line from Macon to Savannah, Ga. The engineers are now making the preliminary survey for the line.

Louisville & Nashville.—It is stated that this company has determined to issue a general blanket mortgage bond covering all underlying mortgages, and providing for present needs and improvements. The total amount of the new mortgage will be about $50,000,000. The bonds will bear 4% interest, and it is proposed to issue them from time to time as the underlying bonds mature. It is probable that the immediate issue will be less than $5,000,000, and a portion of the proceeds of that amount will be used to pay obligations incurred for double tracking and other improvements.

East Tennessee, Virginia & Georgia.—The surveys have been completed and grading commenced on the line from Hazlehurst to Way Cross, Ga., 45 miles.

Norfolk & Western.—About 5,000 men are now at work on the Elkhorn extension of this road. It is stated that the company will build a double track line from Laural Fork to Cromwell, W. Va., 80 miles.

South Bound.—Chief Engineer Geo. D. Wadley is now preparing the profiles and estimates of the first 38-mile section of this road from Savannah, Ga., north, and bids will be received after June 10 for the construction. Bids can be made on the entire work or each portion separately. The offices of the company are at Savannah, Ia.

Ohio River.—It is expected that cons ruction will soon begin on the Ravenswood, Spencer & Glendale R. R.

Projects and Surveys.

East Shore Terminal Co.—A correspondent writes us that this road will be three miles long, connecting the various railways entering Charleston, S. C., with the wharves, and running along the wharves and the streets next to them. All the right of way has been obtained, and tracklaying will begin about June 15. The road will do a freight business only. Geo. A. Evans, of 40 Wall St., New York City, is President.

Columbia, Geneva & Western.—It is stated that the contracts will soon be let for building this Alabama railway. The route is from Columbia to Geneva, Ala., and passes through a fine agricultural and timber country.

Manatee & Sarasota.—It has been decided not to commence the construction of this Florida road until about September.

Poplar Springs, Handly's Lake & Meridian Dummy.—M. N. Brandon, of Meridian, Miss., Chief Engineer, writes as follows:

This road is an extension of another railway and will run from Meridian to Poplar Springs, Miss., a distance of 2 miles. The surveys have been made and the contract let, the road to be completed by Aug. 1. The work is generally light, and grades and curves are easy. W. F. Brown, of Meridian, Miss., is President.

NORTHWEST—Existing Roads.

Jacksonville, Louisville & St. Louis.—Good progress is being made on the extension from Litchfield, Ill., to St. Louis, Mo., and it is expected that the line will be put in operation in July. A traffic arrangement has been made with the Chicago, Santa Fe & California R. R., by which the company obtains an entrance into Chicago.

Chicago & Ohio River.—It is stated that this company will build an extension to Paducah, Ky. Surveys will be commenced at once.

Port Arthur, Duluth & Western.—The bridge across the Kammistiqua River is completed, and arrangements are now being made to continue the road to Gun Flint Lake on the International boundary. The ties, trestle timber and all necessary materials are distributed along the route for 10 miles, and it is expected that this portion of the line will be in operation very soon. Thos. Marks, of Port Arthur, Ont., is President.

Duluth & Winnipeg.—The route of the extension to the international boundary has been located. From La Prairie the road will run along the northeast bank of the Mississippi, passing through Grand Rapids and almost directly northwest, north and east of Lake Winnebagoshish. At a point about 20 miles northwest of the lake it will go northward, crossing "The Neck" in Red Lake and then direct to the boundary, at a point on the southwest corner of the Lake of the Woods. The line will cross but few of the large swamps north and west of the Mississippi. Grading is now in progress between La Prairie and Lake Winnebagoshish, and it is expected that tracklaying will commence about June 15.

Northern Pacific.—The official statement of this road for the nine months ending March 3, shows the following results from operations as compared with the previous year: 1889-90, gross earnings, $16,792,255; expenses, $9,540,613; net earnings, $7,251,642; 1888-89, gross earnings, $14,624,492; expenses, $8,753,071; net earnings, $5,871,421.

Projects and Surveys.

Pueblo & Duluth.—This company has been chartered in Nebraska. The incorporators are William A. Winant, William H. Caputt, Ralph A. Weill and R. W. Carman, of New York; J. M. Coleman, C. A. Williams, Thomas Marwood, G. E. Miller, D. Hitchcock, of Nebraska, and Peter J. Minnahan, M. A. Dunn and John J. Stillson. The roposed line extends from Covington, Neb., opposite Sioux City, southwesterly through the counties of Dakota, Dixon, Cedar, Wayne, Pierce, Madison, Antelope, Boone, Wheeler, Greeley, Valley, Harvard, Sherman, Custer, Buffalo, Dawson, Gosper, Frontier, Red Willow and Hitchcock.

Delavan, Lake Geneva & Pacific.—Press dispatches from Delavan, Wis., are to the effect that a company has been formed there to build a railroad from Lake Geneva to Delavan Lake, and thence to Delavan. It is understood that the road will become either a part of the Chicago & Northwestern or a part of the proposed Wisconsin Central line from Lake Villa to Lake Geneva and Portage. It is expected that the line will be completed to Delavan Lake next season.

Kewaunee, Green Bay & Western.—At a meeting of the directors recently held the following officers were elected: W. J. Abrams, Green Bay, President; George Grimmer, Kewaunee, Vice-President; W. W. Cargill, La Crosse, Secretary and Treasurer, and Charles Joannes, Green Bay, Assistant Secretary. The company proposes to build a line of railway from Kewaunee to connect with the Green Bay, Winona & St. Paul Road at Fort Howard, Wis. Two lines have already been surveyed, and both are practicable. It is believed that the line will eventually be extended to Sturgeon Bay, Wis.

Duluth Transfer.—General Manager Simonds, of the newly incorporated Duluth Transfer Railway Co., is reported as saying:

Already we have a corps of engineers in the field surveying the best routes. We will build from some point in Duluth, along the shore past Rice's Point and near the probable location of future manufactories between the point and Oneota. From West Duluth the route will be along the river to Foud du Lac. As soon as the survey is made we will begin grading, and before 1891 will have part of the road in operation.

SOUTHWEST.

Projects and Surveys.

Kansas City & Excelsior Springs.—Surveys are in progress for this road, which is projected to run from Excelsior Springs, Mo., to a point on the Wabash Ry. near Missouri City. The length of the road will be about 10 miles.

Beebe, Des Arc & Brinkley.—Chartered in Arkansas to build a railway from Beebe, via Des Arc, to Brinkley, Ark., a distance of 51 miles. The route is through a level prairie country. Among the incorporators are: F. P. Laws, of Beebe, Ark.; P. K. Roots, John C. England, A. M. Burton and J. S. Neylon.

Joplin Belt.—At a meeting of the board of directors recently held, S. C. Henderson was elected President; O. H. Picher, First Vice-President; D. C. McConey, Second Vice-President, and W. B. McIntire, Secretary. The belt line company is organized to build a narrow gauge road connecting Webb City, Carterville, Galena, Belleville, Lehigh, Carl Junction, Cox Diggings, Grand Falls and other towns and mining camps of the lead and zinc district with Joplin, Mo. About 30 miles of track will be constructed. Engineers will begin working the survey next week. The line will be built by Joplin capital.

Texas, Sabine Valley & Northwestern.—This company desires to communicate with capitalists and contractors willing to construct 20 miles of railway this season. Work to commence two weeks from date. Rich. J. Evans, Longview, Tex.

ROCKY MT. AND PACIFIC.—Existing Roads.

Union Pacific.—About 70 miles of the grading on the extension to Pioche, Nev., have been completed, and 20 more miles are nearly completed. The graders are now within a few miles of Pioche. It is stated that the company will construct three short branches to the Coeur d' Alene mines in Washington.

Northern Pacific.—The contract for grading the extension from Tacoma to Olympia and Ocaster, and from Centralia to the mouth of the Black river, has been let to Greggs & Heustus, and work is in progress.

Port Townsend Southern.—This company has advertised for clearing, grubbing, grading and bridging, 7¼ miles from Lake Hooker to a point about 20 miles south of Port Townsend, to deep water on Hood's canal, bids to be in this office June 1, 1890. Two mile extension north from Olympia to deep water, principally trestle work, by June 1. Forty miles of clearing, grubbing, grading and bridging from deep water at Olympia to Union City, on Hood's canal, June 15. Forty miles of clearing, grubbing grading and bridging on west bank of Hood's canal from Union City north, July 1. Profiles and maps can be seen at the office of the Chief Engineer, F. A. Hill, Port Townsend, Wash.

Pecos Valley.—On May 26, the contract was let for the grading, bridging, track-laying and material of 100 miles of the Pecos Valley Railway, to W. C. Bradbury & Co., of Denver. This road begins at a point on the Texas Pacific and runs up the Pecos Valley to Eddy, New Mexico, to which point it is already located; from there it will be continued to Roswell, Lincoln Co., N. M., and probably to a junction with the Santa Fe. The present contract is to be completed and the road ready for the rolling stock by December next. Large forces are already gathering at Pecos City and the entire work will be prosecuted with vigor until its completion.

Union Pacific.—The firm of Kilpatrick Bros. & Collins have the contract for this road from Portland, Ore., to Seattle, Wash., a distance of about 480 miles. This is very heavy work and will require nearly two years to complete. There are several long bridges, one over the Columbia River about one and a half miles long.

Projects and Surveys.

Livingston & White Sulphur Springs.—It is stated that this proposed Montana railway, which is projected to run from Livingston to White Sulphur Springs and Castle, will cost about $300,000. The line as surveyed is about 55 miles long, and will open up a fine mineral section of the country.

Snake & Columbia River.—This company has been chartered to build a railway in Washington. The proposed route is from Lewiston down Snake River to Penawawa, thence to Colfax, crossing Rebel and Union flats to Sprague at Pleasant Valley to Davenport and Columbia River.

FOREIGN.

Monterey & Mexican Gulf.—A press dispatch from the City of Mexico says:

T. S. Bullock, Vice-President of the Monterey & Mexican Gulf R. R., now in operation from Venadito to Linares, and owned by New York capitalists, says that the road will be opened to Victoria, in the State of Tamaulipas, distant 212 miles from Venadito, and form a junction with the International in August. Work is to be commenced next month from Tampico toward the eastern end, and it is expected that the two ends will be joined no later than next month. That part of the road now in operation is more than paying operating expenses, and, when completed, it will be one of the best paying roads in the republic.

Hidalgo.—It is stated that the Hidalgo railway now in operation between the City of Mexico and Pachuca, will shortly pass into the hands of an English syndicate which has control of the Honey concession. The railroad runs from the City of Mexico direct to Tampico, with branches to other important points. It is said that by this deal the road will be at once pushed on from the lowlands near Pachuca to Tampico.

Corpus Christi & South America.—This company has been organized at Corpus Christi, Tex., to build a build a railway from that point south along the coast of the Gulf of Mexico to Brownsville, Tex., from which point it is intended to eventually continue it south through Mexico and Central America to South America. The officers of the company are: E. H. Ropes, President; S. H. Mallory, Vice-President and General Manager; N. Gusset, Treasurer; G. W. Westervelt, Secretary. Directors: E. H. Ropes, Perry Doddridge, N. Gusset, J. B. Wells, J. B. Armstrong, R. W. Stayton, Thos. Carson, S. H. Mallory and G. R. Scott.

Cuba.—A press dispatch from Madrid, Spain, says:

It has been decided by the Cabinet to grant the contract for the construction of the Cuban Central Railway to an English syndicate, which offers a better security for the performance of the work than does the American syndicate. The Government will, however, stipulate that some portion of the material used in construction shall be supplied by American firms.

RAPID TRANSIT.

Electric Railways.—Boston parties have leased the Continental Tube Works, of Frankstown, Pa., and will put them in operation at once. The firm will make a specialty of electric railway poles. The poles consist of two tubes of different size, the smaller one being screwed into the larger one by means of a thread. It is claimed they can be made for less than the wooden poles cost.

Several large contracts have already been placed with the new firm, and they have enough orders on hand to run the works for one year.

The Southside Land & Improvement Co. has been granted permission to use electricity on its proposed railway up Seventh St., at Richmond, Va.

Harris & Voss, proprietors of the Athens, Ga., street railway, will build an electric line in Macon, Ga., the coming summer. They have already secured a charter and right of way, and will go to work at once on the road. They will buy plants for the Athens and Macon roads at the same time.

A belt line electric railway will be built around the city of Albany, Ga.

An effort is being made at Atlanta, Ga., to organize a company with $600,000 capital to establish a newly invented system of electric motive power. Laurence Westerland, who invented the Brosius improved sewing-machine motor and perfected its working, is the inventor of the new system.

E. J. Lawless, of Kansas City, Mo., is talking of building an electric railway from Sheffield to Tuscumbia, Ala.

The steel rails for the Winchester, Ky., electric street railway have been shipped, and work will begin on the line at once.

Work will be begun at once upon the Metropolitan electric street railway at Butte, Mont. Mr. Jones, the general Western agent for the Sprague Electric Motor Co., whose system has been adopted, has arrived in Butte, accompanied by a corps of linemen. The necessary wire is already on the ground, and the work of stringing will begin at once.

Horse Railways.—The Suburban Ry. Co., of Orange, N. J., has filed articles of incorporation with the Secretary of State. The corporation is organized for the purpose of operating a street car line between Newark and Orange. The road is to connect with the Newark rapid-transit line, and run through East Orange, Orange and West Orange. The incorporators are: Thomas Nevins, Charles A. Lighthipe, Lawrence T. Fell and Thomas A. Nevins, of Orange; Frederick W. Ward and

William H. James, of East Orange, and Charles W. Trus. low, of Summit.

Essex Passenger Ry. Co., of Orange, N. J., proposes to extend its tracks from its present terminus at Lincoln Ave. along Main St., to St. Mark's Church, and thence along Valley Road to the Edison Laboratory, or to Washington St. The company have in view the further extension of a line through to Montclair. No difficulty will be met in obtaining the consent of the West Orange authorities, and it is probable that at the next meeting of the Orange Common Council the franchise will be granted.

The stock company that controls the Second Avenue and West End Street Railway lines in Pittsburg, Pa., proposes, during the coming summer, to make extensive improvements in its roads, and in one instance at least reduce the fares from ten cents to five cents. Two new lines connecting suburban towns, Mansfield and Sevenmile Island, are to be built, and a ferry is to be operated between Homestead and Glenwood, making the fare from Homestead to the Exposition building in Pittsburg ten cents.

Wayne Griswold, one of the trustees who purchased the Kalamazoo, Mich., street railway, states that as soon as they get possession the bondholders will put $15,000 to $20,000 in improvements, extend the lines and make it a first-class horse railroad. He does not believe in overhead electric car service, and thinks the storage system in a few years will be the only street car motive power.

The material for the street railway at Pittsburg, Kan., is all on hand and construction will commence at once.

The San Antonio, Tex., city council has granted right of way over some of the principal streets to the San Antonio Street Ry. Co. The new line will run to San Pedro Park, and has been brought into existence by the keen competition among the various railroad transportation companies.

A company is being formed at Laramie, Wyo., to construct a street railway.

Cable Railways.—M. T. Marca, C. E., Lima, Peru, S. A., has the contract for building cable tramways in that country and will be obliged for trade catalogues of supplies, etc., addressed as above.

Dummy Railways.—A dummy railway is to be constructed from Greeneville to Paris, S. C.

Messrs. Geo. M. Pullman and George Westinghouse, Jr., are reported as contemplating the formation of a company for constructing and equipping electric street railways. It is mere rumor as yet.

The Sioux City Street Ry. Co. has ordered eight more electric motors for its various lines.

HIGHWAYS.

Rhode Island.—The Providence City Council has voted an appropriation of $7,000 to purchase a steam road roller and crusher. Simon W. Simmons and John Walsh were appointed a committee to purchase the machines. The sum of $20,000 was also voted to macadamize Plainfield turnpike.

West Virginia.—Sealed proposals will be received at the office of the Clerk of the County Court of Marshall Co., W. Va., until Monday, June 17, 1890, at one o'clock P. M., for furnishing bed rock, and macadamizing 1¼ miles of the county road from the corporation line of the town of Cameron, to the Clouston church. Specifications furnished on application to Thos. Finn, Clerk County Court, Moundsville, W. Va.

Alabama.—The County Commissioners of Jefferson County, Ala., will issue $50,000 of bonds, the proceeds to be used in highway improvements.

Kentucky.—Bills have been introduced into the State Legislature incorporating the Booneville, Beattyville & St. Helens Turnpike Co., and the Shelbyville & Eminence Turnpike Co.

WATER-WORKS.

NEW ENGLAND.

Franklin Falls, N. H.—At a recent meeting of citizens the cost of establishing works to supply the two towns was estimated at $60,000 to $70,000.—The paper company proposes to lay a large pipe from Cross Pond to supply their mills with clean water. "They will furnish hydrants at a reasonable price and this will cover the business part and a large section of this village. It may be the best plan to take water in this way, but yet it would be preferable to cover all of both villages."

Greenfield, Mass.—The Water Commissioners have ordered 1,300 ft. of 6-in. mains to be laid to the Wiley & Russell works, also several hundred feet of 4-in along Orchard street.

Woburn, Mass.—The Water Committee has voted to lay another supply main to the reservoir. Estimated cost, $6,000.

Marblehead, Mass.—The following proposals for laying cast-iron water pipe, rock excavation, etc., were opened on April 29. F. L. Fuller, of Boston, is the engineer in charge.

	10 in.: 1,142 ft.	8 in.: 18,830 ft.	6 in.: 20,987 ft.	4 in.: 1,625 ft.	4,500 cu. yds. rock excavation.	8 connections with old 10-in. pipe.	Total Bid.
J. E. Hillpot, Philadelphia	$ 0.32½	$ 0.28½	$ 0.24½	$ 0.19	$ 2.30	86	
	371.15	5,366.55	5,141.81	308.75	10,350.00	48	$21,586.26
J. C. Coates, Boston	.33	.29	.23	.21	3.25	5	
	376.86	5,460.70	4,827.01	341.25	14,625.00	40	25,670.82
E. E. Eglee, New York	.35	.28	.24	.22	3.50	10	
	399.70	5,272.40	5,036.88	357.50	15,750.00	80	26,816.48
*W. J. Dean, Salem	.30	.27	.24	.20	3.60	10	
	342.60	5,084.10	5,036.88	325.00	16,605.00	80	27,293.58
Gore, Little & Co., Cambridgeport	.40	.31	.27	.20	3.40	15	
	456.80	5,837.30	5,666.49	325.00	15,300.00	120	27,705.29
F. E. Shaw, Providence	.30	.25	.21	.18	4.00	15	
	342.60	4,707.29	4,407.29	292.50	18,000.00	120	27,869.87
G. W. Mantle, New York	.31¼	.28	.25	.20½	3.95	10	
	362.59	5,272.40	5,246.75	333.13	17,740.00	80	29,064.87
J. T. Langford, Boston	.26¼	.26¼	.26¼	.26¼	4.00	10	
	302.63	4,989.95	5,561.55	430.67	18,000.00	80	29,364.75
J. J. Newman, Providence	.38	.31	.27	.23	4.00	15	
	433.96	5,837.30	5,666.49	373.75	18,000.00	120	30,431.50
T. W. Harris & Co., New York	.33	.29	.26	.20	4.45	15	
	376.86	5,460.70	5,456.62	325.00	23,325.00	120	31,764.18
F. D. Mayo, Lynn	.44	.38	.35	.30	4.00	15	
	502.48	7,155.40	7,345.45	487.50	18,000.00	120	33,610.83
Ferris & Halliday, Jersey City	.36	.31	.27	.23	5.00	35	
	411.12	5,837 30	5,666.49	373.75	22,500.00	280	35,068.66
D. O'Connell, Dorchester	.40	.38	.37	.36	4.25	2	
	456.80	7,155.40	7,765.19	585.00	19.125.00	16	35,103.39

*Awarded the contract.

Winchester, Mass.—A bill has been introduced in the Senate to authorize an issue of $25,000 of water bonds.

Lynn, Mass.—A second order has been passed by the City Council, authorizing the issue of $75,000 of bonds for improvements.

Great Barrington, Mass.—The town has voted to purchase the plant, franchises, etc., of the Berkshire Heights Water Co. A. C. Collins, M. I. Wheeler, C. J. Taylor, P. A. Russell and J. D. Noxon have been appointed a committee to open negotiations with the company.

West Newton, Mass.—Albert F. Noyes, City Engineer of Newton, Mass., has sent us the following information:

The supply for this town is to be obtained by extending the mains from Newton and constructing a filtering conduit with tube wells driven into it. A 2,000,000-gall. covered reservoir will also be built.

Jamestown, R. I.—George H. Norman, of Newport, R. I., has been awarded a 30 years' franchise for putting in a complete system of works. Construction is to be commenced at once, and the thickly settled part of the town is to be supplied with water in six weeks. Water will be pumped from springs to an iron stand-pipe; 13,000 ft. of pipe will be laid, and 25 hydrants will be set. The contract price is $30 per hydrant.

Hartford, Conn.—The Chairman of the Board of Water Commissioners has been instructed to have an estimate made of the cost of building a new dam, the plans for which are now on file. This work, as well as the proposed laying of a new main at an estimated cost of $45,000, is projected with a view to furnishing the elevated parts of the city with a better pressure.

MIDDLE.

Cohoes, N. Y.—A resolution has been passed by the Water Board awarding the contract for 25 hydrants to the Eddy Valve Co., of Waterford, N. Y.—The contract for pipe was awarded to the Utica Pipe Co., at $28.80 per ton.

Troy, N. Y.—Additional hydrants are to be set on River St. A petition has been received asking for a new main on Eleventh St.

Hermon, N. Y.—The following information has been received from P. L. Doyle:

The town has voted to expend $5,000 in establishing a water supply for fire protection only. The proposed plan is to put in works for fire protection, and induce the taxpayers to vote another appropriation for putting in works for domestic use. The estimated cost of the completed works is $12,000. No engineer has been appointed. Water will probably be pumped from a spring to a stand-pipe. E. A. Conant is the Village President. Contracts will probably be let in July.

Glens Falls, N. Y.—The bill allowing the village to issue bonds for $45,000 for extending and repairing the water-works has been signed by Governor Hill.

Montclair, N. J.—J. Van Vlic't, T. Russell, S. W. Carey, J. H. Parsons and others have been appointed committeemen by the Township Committee to negotiate with the water company for the purchase of its works.

Millvale, Pa.—The contract for building the new water-works has been awarded to James H. Harlow & Co., Pittsburgh, Pa.

Bel Air, Md.—The new works will be put in by James H. Harlow & Co., Pittsburg, Pa.

SOUTHERN.

Lynchburg, Va.—The Lynchburg Construction Co. has been organized to construct water-works and to lay steel and iron pipe, etc. President, W. H. Ford; Secretary, J. M. Hughes; Superintendent, James Allen.

Blacksburg, S. C.—The town has contracted with the Blacksburg Land & Improvement Co. for a water supply.

Albany, Ga.—The City Council has accepted the proposition of Col. Tift to supply the city with water.

Eatonton, Ga.—We have received the following from B. D Lumsden, of Macon, Ga.:

Capital is wanted for constructing a system of works to cost from $8,000 to $10,000 by B. D. Lumsden. It is proposed to secure the supply by constructing a dam across a small creek, about one mile from the town. Work will probably be commenced this summer.

Fort Valley, Ga.—R. J. Edenfield, of Waynesboro, Ga., has been awarded the contract for sinking an artesian well from which to draw the supply for the proposed works.

Macon, Ga.—It is reported that if the injunction restraining the issuance of $200,000 of bonds for paving, sewering, etc., is sustained, authority to issue $100,000 of bonds for constructing water-works, to be operated by the city, will be asked for.

Tennille, Ga.—Bids are wanted for constructing works. Address J. C. Harman, Mayor.

Green Cove, Fla.—N. B. Ivey has made a proposition to the town to put in works.

Tallahassee, Fla.—The new works have been completed and satisfactorily tested. Water is taken from Houston Springs.

Ocala, Fla.—The city has decided to purchase the company's works.

Pass Christian, Miss.—The West End Artesian Well Co. has obtained a copious flow of water.

NORTH CENTRAL.

Lima, O.—Superintendent D. E. Fritz informs us that about 7,500 ft. of 4 and 6-in. pipe will be laid this season, and that 7 new hydrants and 10 new valves will be set.

Warsaw, Ind.—The quality of the water is to be improved either by filtering or by securing a new source of supply.

Hudson, Mich.—J. D. Cook, C. E., of Toledo, O., informs us that contracts for the supplies have been awarded as follows: Furnishing pipes and special castings, Addystone Pipe and Steel Co., Cincinnati, O., at $23.97 per ton. Pipe laying, Snyder & Williams, Dayton, O., at $4,37.42. Pumping machinery, Hughes Steam Pump Co., Cleveland, O., 2 compound non-condensing, duplex pumping engines, 1,000,000 galls. capacity each, at $4,380.50. Boilers, Lansing (Mich.) Iron and Engine Works, 2 54 × 14-in. tubular boilers, set up complete, $2,000. Valves, Rensselaer Mfg. Co., Troy, N. Y., at $460. Hydrants, Bourbon Copper and Brass Works 51 5-in. double-nozzle hydrants with frost cases, to be covered, 5 ft., $1,428.

Antigo, Wis.—At a special election held on May 31, to decide the question of building works, the measure was carried by a vote of 621 to 39. A franchise will be granted and work commenced at once.

NORTHWESTERN.

Sioux City, Ia.—About $25,000 is to be expended in laying new mains.

Superior, Minn.—Additional mains are to be laid.

Minneapolis, Minn.—The Water Committee is in favor of laying a large main to the business portion of the city from the North Side pumping station. City Engineer Rinker has been instructed to select a route and make an estimate of the cost of extending the 36-in. pipe from Twentieth avenue north to Fifth avenue south.

Belleville, Kan.—The city has purchased the Belleville Light & Water Co.'s plant.

Medicine Lodge, Kan.—Civil Engineer D. J. Aber informs us that the new works were satisfactorily tested on May 23.

Fargo, No. Dak.—A vote will be taken on June 23 to decide the question of issuing $85,000 of bonds for securing a system of works to be owned and operated by the city.

Miles City, Mont.—The electric light company has contracted to furnish a water supply. Work has been commenced.

SOUTHWESTERN.

Macon, Mo.—The citizens have cast a majority vote of 625 to issue bonds for a system of water and electric light works.

St. Louis, Mo.—The Board of Public Improvements has passed an ordinance authorizing the board to lay distribution pipes as petitioned, and appropriating $15,000 for the same. An ordinance was also passed to procure pipes, valves, fire-plugs and special castings to be used in the extension, and appropriating $50,000 therefor. The Committee on Public Improvements has favorably re-

ported the ordinance authorizing the Board of Public Improvements to advertise for bids, and award contracts for the construction of six settling basins at the Chain of Rocks, to cost about $750,000. The contract for constructing section "A" of the low-service conduit has been awarded to J. O'Donnell & Bro., at $108,348.50.

Cape Girardeau, Mo.—The following is from P. A. Hoch:

Bids were opened some time ago, but no contracts have yet been awarded. The Mississippi River is the proposed source of supply.

Houston, Tex.—Artesian well No. 14 has been completed. It is 8 ins. in diameter, 500 ft. deep, and yields 400,000 galls. daily. Gus Warnecke was the contractor.

Rockdale, Tex.—The Rockdale Water-Works has been formed with a capital of $50,000.

Denton, Tex.—W. H. Camp, of Larned, Kan., has been granted a franchise to build works.

Albuquerque, N. M.—The question of purifying or obtaining a pure water supply is being discussed.

PACIFIC.

Bellingham, Wash.—The attempt to obtain a water supply from artesian wells has been unsuccessful. It is now proposed to run a supply pipe from Lake Sehome.

Santa Ana, Cal.—The City Trustees have accepted the proposition of Leslie, Holmes & Olmstead to put in a direct pressure system of works, and erect a stand-pipe to furnish a reserve supply. An election will soon be held to vote on the question of issuing $50,000 of bonds.

East Whittier, Cal.—The East Whittier Land and Water Co. has filed articles of incorporation. The incorporators are: S. J. Murphy, Detroit, Mich.; J. P. Sanborn, Port Huron, Mich.; G. R. Thomas, Pasadena; A. L. Reed, East Whittier, and J. M. Sanborn, East San Gabriel. The capital stock is $1,000,000, all of which has been taken.

Ashland, Ore.—Work has been commenced.

Boise City, Idaho.—Eastman Bros. are putting in a complete system of works. The supply is taken from springs.

Salt Lake City, Utah.—The Utah Water Co. has made a proposition to purchase the existing works.

CANADA.

St. Cunegonde, P. Q. (P. O. at Montreal, P. Q.)—The city of St. Cunegonde of Montreal invites tenders for $400,000 of 40-year 4 per cent. bonds until June 26. Address G. N. Ducharme, Treasurer.

New Westminster, B. C.—Tenders will be received until July 14 for supplying the material and laying the main pipe for the new works. Arthur Hill is the Engineer.

PROJECTS.

Statesville, N. C.; D. A. Miller, Mayor.—Yoakum, Tex.—Riverton, Ala. (P. O. at Chickasaw); North Alabama Development Co.—Madison, Ga.—Blaine, Wash.—Fleetwood, Pa.

ARTESIAN WELLS.

Yankton, So. Dak.—Efforts are being made to organize a company to sink a largewell, the water to be used for motive power.

Chinook, Mont.—Machinery for boring wells has arrived and work will be commenced at once.

Woonsocket, So. Dak.—E. Rohreur, Huron, So. Dak., has signed a contract with the Woonsocket Milling Co. to put down a 7-in. well for power to operate the company's mill.

Marlin, Tex.—Bids will be received until June 15 for sinking a well by W. Shelton, Mayor.

Corsicana, Tex.—Bonds will probably be issued for sinking a well.

New Orleans, La.—It is reported that the New Orleans Auxiliary Sanitary Association intends expending $10,000 in sinking wells. Secretary, Edward Fenner.

Wolsey, So. Dak.—City Treasurer N. W. Vance has disposed of $2,500 of artesian well bonds at par. It is expected that the contract with Swan Bros., of Andover, will be signed and work begun within a few days.

IRRIGATION.

Russell Springs, Kan.—The Smoky Hill Irrigating Co. has been incorporated at Topeka. The directors are: John Kirkman, L. S. Kirkham, George C. Fleming, J. R. Childres, J. W. Jones. Capital stock $1,000.

Riverside, Cal.—The citizens have voted to form the Perris Irrigation District.

SEWERAGE AND MUNICIPAL.

London, Ontario, proposes to build a brick sewer along Carling Creek at an estimated cost of $83,370. It may be increased in cost, by extension, to $111,870.

Streetwork.—Wilkinsburg, Pa., has let contracts to Booth & Flynn, for Paving Penn Ave., at $4 per sq. yd, for stone block, or $3.60 for asphalt, or $2.18 for fire-brick; the council committee is to decide which they will adopt.

Brooklyn, N. Y., let contracts, on May 21, for grading and paving Bergen St. with cobble stone, at prices per lineal foot ranging from $2.85 to $4.45.

Dayton, O.—The City Commissioners have instructed City Engineer F. M. Turner to prepare plans, specifications, estimates of cost, etc., for paving Third St. with granite blocks for a distance of about 3¼ miles; River St. with granite for 900 ft., and Washington St. with vitrified brick for about 4,800 ft. A number of other streets are also under consideration for improvement.

Troy, N. Y., is discussing brick street pavements, and while there seems to be a strong contingent of councils in favor of it, opinions differ on the value of a concrete base for the pavement.

Columbus, O, has authorized the paving of several of its streets with other asphalt, stone block, Hayden block, Hallwood block, or other fire-brick pavement as the bids may decide.

Lyndhurst, N. J., is to vote on June 10 whether or not the town shall be bonded for $12,500 for macadamizing its streets.

Minneapolis, Minn., is to pave Park Ave. with asphalt. The invitation for bids restricted the price to $2.75 or less per yard. Under the restriction and other conditions the Barber Asphalt Co. and the Western Supply & Paving Co. declined to bid, and the contract was let to the Warren-Scharf Co. at $2.75 per yard for paving and 45 cts. per cu. yd. for extra excavation. The contract requires the pavement to be kept in good condition until July, 1895, and the company proposes for 9 cts. per yd. extra to guarantee it until 1900. The latter proposition can be accepted by the city at the end of the first five years. This company must accept the citizens' proportion of $81,000, payable in five annual instalments; the city's proportion is payable in July, 1891. The contract price is $120,000.

Washington, D. C.—A Congressional committee has reported favorably upon the appropriation of $7,500 for building a macadam road on Market St. to the National Cemetery. A bill is also before Congress, and favorably reported, providing for a permanent system of highways in the immediate suburbs of the city. It directs the commissioners to prepare plans conforming as much as possible with the present street formation and location of Washington; the highways to be not less than 90 ft. nor more than 160 ft. wide.

Atlanta, Ga., wants to lay asphalt on Peachtree St., in that city, which already has a base of 6 ins. of concrete on part of it.

Clifton, O., is to issue bonds for improving Morrison Ave. in that town.

Reading, Pa., failed to pass an ordinance ordering the paving of N. Fifth St. with asphalt. It was a test vote as to whether it was expedient to generally repave the streets of that city.

Columbus, O., has passed ordinances authorizing the improvement of a number of streets.

Rochester, N. Y., gives public notice of the intended opening and extension of a number of streets and boulevards. Asphalt, Medina stone pavements and cement walks enter into the improvements.

Detroit, Mich., has appropriated $250,000 for repaving streets, and has $57,000 left over from last year's repaving fund. They are about to let contracts covering this joint amount.

St. John, N. B., reports through City Engineer R. W Roberts, that at the close of 1889 that city had 16.4 miles of cedar block pavement laid, or 296,158 sq. yds. This has all been laid during the last 10 years. Allowing a life of 10 years and its renewal at 85% of the original cost, the question of adopting a more desirable pavement is being discussed. Brick pavement is being considered, and the Board of Public Works indorses the recommendation for a better pavement, as the present large areas of decayed wood is considered prejudicial to public health.

Minneapolis, Minn., is to have a magnificent public park of 125 acres donated to the city by Colonel King, Mr. H. F. Butler and Mr. J. M. Fogg.

Rochester, N. Y., will soon extend the Boulevard, 100 ft. wide, to the north limit of the city; macadamize Reynolds St., 26 ft. wide, at an estimated cost of $9,450, and extend Alexander St.

Providence, R. I., advertises considerable street paving and curbing work.

Sewerage.—Brooklyn, N. Y.—Bids will be opened on June 11 for building the Greene Ave. relief sewer. The estimated cost is $1,000,000. The work will be let in two sections, one including the open cut, and the second a tunnel section three miles long. The maximum diameter of the new sewer will be 15 ft.

Dayton, O.—City Engineer F. M. Turner is engaged on the preliminary surveys for a sewerage system to cost $500,000. It is, however, contemplated to build only to the extent of $250,000 at first.

Olympia, Wash., has ordered a complete sewerage system, and also the grading of 20 new streets.

Geneseo, N. Y., sewer commissioners have directed the preparation of specifications for sewerage.

Kingston, Jamaica, has adopted the sewerage plans of Col. Geo. E. Waring, Jr., and the work is to be carried out by Messrs. Waring, Chapman & Farquhar, of Newport, R. I. Col. Waring is also engaged as Consulting Engineer in the following works: By the Cumberland Gap Park Co., to lay out 1,000 acres as a winter resort, with a hotel for 500 guests, a $50,000 casino and a sanitarium with a capacity of 100 patients; as Consulting Engineer for the N. C. Steel and Iron Co., of Greensboro, N. C., to lay out a manufacturing town with an area of 2,000 acres; the Harrowgate Land Co., near Middlesborough, Ky., is laying out 700 acres, under Col. Waring's direction, as an ornamental village for business men of Middlesborough, and for the Middlesborough Town Co. he is also regulating Yellow Creek at a cost of $100,000, and will sewer the town.

Mount Vernon, N. Y., has been authorized by the Legislature to issue $50,000 bonds for lateral sewers. It is estimated that this amount will be insufficient, and the taxpayers have voted $50,000 more to meet this deficiency.

Kansas City, Mo.—The O. K. sewer project, mentioned last week, has been postponed, awaiting better location and revision of grades.

Washington, D. C.—The friends of the Rock Creek Park bill, lately defeated, are pushing for a reconsideration. It is either a question of a sewer or a park, as this creek takes the drainage of a large area, and if this is to be used for settlement, it means an expenditure of $10,000,000 to wall it in. The Park would cost $1,200,000.

Allegheny City, Pa.—The councils have authorized the construction of a lateral sewer on Western Ave., from present terminus to Grant Ave. The work is to be advertised soon. Other sewers are under discussion.

Brooklyn, N. Y., announces the award of sewer work, on May 21, at the following prices: 30-in. brick sewer, $3.25, $3.87 to $4.00 per lin. ft.; 24-in. cement pipe, $2.00, $2.30 to $2.50 per ft.; 18-in. cement pipe, $1.40, $1.6 to $1.70; 15-in. cement pipe, $1.30, $1.40 to $1.55; 12-in. cement pipe, $1.00 $1.08 to $1.30; each manhole complete, $35; each street basin complete, $100.

Cuba, Allegheny Co., Pa., is discussing a complete system of sewerage, and a sewerage commission has been appointed.

Troy, N. Y., authorizes the construction of a number of brick sewers, egg-shaped, to be constructed "as soon as possible."

Syracuse, N. Y., has authorized the construction of 18-in. tile sewer, to cost $1,500.

Orange, Mass., is constructing nine miles of sewers, according to a late resolution to properly sewer that town.

METROPOLITAN SEWERAGE COMMISSION.

Section A. Main Sewer, Boston. Canvass of Bids, May 28, 1890.

Bidders. [All from Boston or vicinity, except the 7th (Yonkers, N. Y.) and last (Chester, Pa.)].	Earth excav. and refill. 3,700 l. ft.	Rock excavation. 50 c. y.	Brick masonry, American. 925 c. y.	Brick masonry, Portland. 100 c. y.	Concrete masonry, American. 2,000 c. y.	Concrete masonry, Portland. 425 c. y.	Spruce lumber in place. 240M. ft. b.m.	6-in. under-drain in place. 500 l. ft.	8-in. under-drain in place. 700 l. ft.	10-in. under-drain in place. 1,000 l. ft.	12-in. under-drain in place. 1,500 l. ft.	Spruce piles driven. 32,000 l. ft.	Cobble-stone paving. 25 sq. y.	Earth excav. and refilling outside of trench. 500 c. y.	Total.
Edward F. Brigham	$12.00	$5.00	$14.00	$15.50	$6.50	$7.75	$30.00	$0.25	$0.35	$0.58	$0.65	$0.18	$0.25	$1.00	$90,835
M. M. Trumbull	11.75	1.25	14.50	16.00	5.75	7.50	29.00	0.35	0.50	0.80	1.00	0.20	0.60	0.85	89,862
Jno. Cavanagh & Co.	11.65	4.50	13.50	15.00	6.50	7.50	28.00	0.45	0.55	0.60	0.65	0.14	2.00	1.25	87,565
Wm. H. Ward	10.50	4.00	11.00	16.00	6.50	8.00	30.00	0.33	0.50	0.70	1.00	0.15	1.00	0.50	84,990
Harry P. Nawn	10.00	5.00	13.00	16.00	6.00	8.00	30.00	0.50	0.60	0.70	0.80	0.15	5.00	1.00	81,470
Perkins & White	8.60	0.10	16.40	17.00	5.00	8.50	20.00	0.12	0.15	0.50	0.50	0 40	0.50	0.20	81,435
Eversop & Liddle	8.95	4.50	11.00	12.75	5.50	6.75	28.00	0.40	0.45	0.55	0.65	0.14	1.00	0.70	72,274
Ntl. Const'n. Co.	8.33	1.00	13.15	14.50	4.85	6.25	28.00	0.25	0.35	0.45	0.65	0.15	1.00	1.00	70,681
Orrin P. Roberts	7.10	2.00	13.12	14 37	5.00	6.35	25.00	0.25	0.35	0.45	0.60	0.16	0.50	0.60	65,794
Chas. Linnehan	6.90	4.00	12.00	13.50	4.75	5.75	24.50	0.50	0.60	0.75	1.00	0.18	1.00	0.75	64,084
Henry C. Eyre	5.60	2.00	11 00	12.00	6.00	7.00	23.00	0.30	0.50	1.50	1.78	0.17	2.00	0.60	63,150

Section B. Main Sewer. Boston and Brookline. Canvass of Bids, May 28, 1890.

	3,000 l. ft.	50 c. y.	750 c. y.	135 c. y.	1,600 c. y.	160 c. y.	60M. ft. b.m.	300 l. ft.	400 l. ft.	800 l. ft.	1,500 l. ft.	4,500 l. ft.	25 sq. y.	500 c. y.	Total.
Henry C. Eyre	$4.80	$2.00	$11.00	$12.00	$6.00	$7.00	$23.00	$0.30	$0.50	$1.50	$1.78	$0.17	$2.00	$0.60	$41,745
Orrin P. Roberts	7.62	2.00	13.12	14.37	5.00	6.35	27.00	0.25	0.35	0.45	0 60	0.17	0.50	0.60	47,928
Everson & Liddle	8.75	4.50	11.00	12.75	5.50	7.15	28.00	0.40	0.45	0.55	0.65	0.17	1.00	0.75	50,950
Natl. Const. Co.	8.57	1.00	13.65	15.00	5.05	6.55	29.00	0.25	0.35	0.45	0.65	0.15	1.00	1.00	51,640
Edwd. W. Brigham	9.00	2.00	13.85	15.20	5.97	7.00	29.50	0 25	0.35	0.52	0.65	0.16	0.25	1.00	54,814
Wm. H. Ward	10.00	4.00	14.00	16 00	7.00	9.00	30.00	0.33	0.50	0.70	1.00	0.15	1.00	0.50	60,609

Waterville, Me., has appropriated $10,000 for the construction of sewers.

Winnetka, Ill., wants to build a 36-in. sewer at a cost of $9,000, on Elm St. The tax-payers on the street object vigorously, however.

Rochester, Minn., proposes to sewer the town with disposal into the Zumbro river.

St. Paul, Minn., advertises a large amount of sewer work, and also street improvement.

Newport, R. I., has commenced rebuilding its sewer outlet.

Lowell, Mass., has voted a loan of $75,000 to be used in diverting sewage from the Middlesex Company's mill pond. A loan of $20,000 for common sewers was defeated at the same meeting.

Columbus, O., has taken the first steps in authorizing the construction of a system of intercepting sewers. Mr. George E. Waring, Jr., C. E., is to be the consulting engineer.

Buildings.—Martinsburg, Va., is to have a public building to cost $75,000.

Augusta, Me.—Architect E. E. Lewis, of Gardiner, will make the plans for a $10,000 school house to be erected on Cushnoc Heights.

Detroit, Mich.—The heirs of Cullen Brown are to build a $60 000 block on Woodward Avenue and Witherell Street, in that city. It will be of Sioux Falls granite, seven stories high.

Dalton, Ga., is to build a $25,000 court house

Birmingham, Ala.—Messrs. Hillman and Handley will build a magnificent stone building on a block 400 x 125 ft. on Powell Avenue. It will contain 16 wholesale stores on the first floor and five retail stores on the second floor, with society halls, etc.

Lexington, Mass., has appropriated $55,000 to build a new grammar school.

Dickinson Co., Iowa, has voted to issue $15,000 in bonds or building a court-house at Spirit Lake.

City Bonds.—Kirkwood, Mo., has received bids for $10,000 10-20 bonds at 4½ per cent. interest, voted for street improvements. The bonds were awarded to W. G. Hayes & Sons, St. Louis, at $102.50.

Chicago, Ill., advertises for proposals for the purchase of $934,000 city 3½ per cent. bonds, to be dated July 1, 1890, to replace a like amount maturing on that date.

Detroit, Mich., sold on June 2, $240,000 of 4 per cent. sewer bonds, dated July 1, 1890, premium not given. Detroit has an indebtedness of $1,932,500, not including $1,326,000 water bonds.

ELECTRICAL.

Electric Lighting.—The Ellsworth, Me., electric light plant was sold at auction last week by Judges Wiswell and Emery as trustees. The Brush Electric Co., of Cleveland, O., made the highest bid and are now owners of the property. F. S. Palmer, of Bangor, has been engaged as agent of the Brush Co., and will be manager of the local company which is to be reorganized. The Brush Co. will make extensive improvements in the plant, among other things introducing the Brush alternating system of lighting, building a new brick station, putting in a 48-in. water wheel, etc.

The managers of the Bridgeport silk mill, of Bridgeport, Conn., have decided to place in their establishment an electric motive power plant to take the place of steam power at present employed. The company has recently purchased 20 new machines, and the managers find the present steam engine of insufficient horse power to run the entire plant with this extra addition. The purchase of a new engine would require a heavy outlay, almost equal to the adoption of the electric system.

Hartford, Conn., capitalists have a scheme for damming Farmington River, and obtaining a fall of 27 ft. and thus furnishing about 2,000 horse power. The Hartford Electric Light Co. has secured the use of 600 horse power for running its dynamos, and also for motors. The capital stock of the water-power company is $100,000, said to be nearly all taken up.

The board of trustees of Johnstown, N. Y., have closed a contract with the Johnstown Electric Light & Power Co. to light the village for two years with 2,000-candle power arc lights at $75 per light per year, the company to furnish 50 lamps or more if needed.

A. J. Acord, of Iron Gate, Va., will erect a small electric light plant.

The Anderson Electric Light & Power Co., has been chartered to furnish light and motive power at Anderson, Va. J. E. Roddy, of Rock Hill, Va., is interested.

The Georgia & Tennessee Construction Co. has been incorporated by H. M. Smith, of Floyd County, and G. H. Aubrey, to develop mineral and timber lands, build and operate electric light, gas and water-works, factories, etc., at Cartersville, Ga. The capital stock is $50,000.

The Loomis Manufacturing Co., of Fernandina, Fla., will put an electric light into its fibre factory.

An electric light plant will be erected at Riverton, Ala.

D. P. West, of Montgomery, Ala., will erect an electric light plant at that place.

The Anniston Gas & Light Co. has the contract for electric lighting at Oxford, Ala.

An electric light plant is talked of at Dayton, Tenn.

Superior, Minn., is laying underground wires for its electrical street lighting system.

Work will soon commence on an electric light plant for the village of Sheldon, Ia.

The city of Laredo, Tex., will put in 20 additional lights.

The Sherman Oil and Cotton Co., of Sherman, Tex., will put in a 50 arc light dynamo.

The Bozeman, Mont., Electric Light Company will have their new power running by August 1st. Their new plant for residence lighting is now on the way. Meters will be placed in residences and the cost of lighting will be placed at a minimum figure.

A new dynamo will be purchased for the electric light system at Berkeley, Cal.

The electric light plant at Dayton, Wash., was entirely destroyed by fire recently. The loss is about $10,000. It will be replaced.

The City of Hoquiam, Wash., expects her electric light plant very soon, and in the meantime active preparations are being made for its speedy accommodation. The power house is being constructed and the poles are fast being put in place for the stringing of the wires. The dynamos provide for 750 sixteen c. p. incandescent and sixty arc lights, to be driven by a 100 h. p. compound engine.

Work will commence at once on building the pole line for the electric light plant at Napa, Cal.

BRIDGES, TUNNELS, AND CANALS.

Bridges.—*East Berlin, Conn.*—The Berlin Bridge Co has recently taken some large contracts. Three iron buildings to be built by it are to go to Bolivia, South America. A large bridge is being built for the Old Dominion Land Co., at Newport News, Va. This is a branch of the Chesapeake Dry Dock Co., for which they are building over $200,000 worth of iron buildings. Four large bridges are to be put up in Jefferson Co., Pa. They will also build the new rod mill for the Holmes, Booth & Hayden Co. at Waterbury, Conn., entirely of iron. It will be 100 feet wide and 150 feet long.

Cleveland, Cincinnati, Chicago & St. Louis R. R.—This company has let the contract for five large bridges to be placed within 90 days on the Indianapolis and St. Louis divisions. They replace lighter bridges constructed 10 or 12 years ago when engines weighed only 50 tons.

Baltimore Co., Md.—The County Commissioners have opened proposals for the building of a bridge over Scott Level run, on the road leading from Pikesville Station, on the Western Maryland R. R., to Randallstown, and for the construction of the abutments of a bridge on the road leading from Phœnix, on the Northern Central R.R., to the Jarrettsville pike, tenth district. The bidders and prices were: For the bridge over Scott's Level run, John H. Beckley, $441; Nathaniel Watts, $519; W. T. Cox, $474. For the abutments of the bridge near Phœnix: John H. Beckley, $365; Francis M. Ford, $200; Albert Weber, $389; Henry Zinkhan, $190; Shipley & Conklin, $1.95 per perch, amounting to $214; Noah F. Hedrick, $298; John T. Devin and Amos Schultz, $329; Andrew Meisner, $250. The contract for the bridge was awarded to W. T. Cox, and for the abutments to Henry Zinkhan.

Baltimore, Md.—The ordinance asking for an additional appropriation of $80,000 to complete Light. St. bridge has been passed by the City Council.

Huntington, W. Va.—The contractors for the construction of the Norfolk & Western Ry. bridge across the Ohio at this point are pushing the work very rapidly, and it is hoped that the bridge can be completed during the present year. The bridge and its approaches are being built wide enough for a double track. There will be no wooden trestles on the line of the extension in West Virginia. Wherever it is possible stone abutments are being put in and fills made, and where the elevation is too great for this iron trestles will be erected.

Wheeling, W. Va.—The plans for the new bridges to the Island and Ætnaville have been completed. The bridge to the Island is 1,989 ft. over all. From Main street to the first abutment is a fill of 166 ft. and 52 ft. wide. The first span is 225 ft., the channel span 525, the third span 295 ft., and a steel viaduct 778 ft. long leads to Penn street. The channel span is 90 ft. above low water. At South Front street a stairway 90 ft. long will take foot-passengers up to the bridge. The bridge to Ætnaville will have three piers and four nearly equal spans.

Augusta, Ga.—A press dispatch says:

A company of northern capitalists have bought a large tract of land across the Savannah River which they propose to improve and make a handsome suburb of Augusta and a famous winter resort. They will erect a magnificent hotel, build electric railways and make it a notable place. They will build a bridge across the river to run their electric cars over to Augusta, and the bridge will also contain carriageway and foot passages free to the city andthe public. A number of New York capitalists are interested in North Augusta and will begin work at once.

Dalton, Ga.—Contracts will be let on June 28 for the construction of an iron bridge across Mill Creek. J. C. Norton, Dalton.

Lamar's Mills, Ga.—Bids will be received until June 17 for the construction of a bridge across Towaliga River. J. A. Daniel, Lamar's Mills.

St. Charles, Mo.—The material is on hand and work will soon begin on the pontoon bridge at this place.

Kansas City, Kan.—The county commissioners will be asked to grant the Kansas City Bridge & Iron Co. further time to complete the Eighth street bridge across the Kaw River. This company was awarded the contract to build the bridge several months ago, and it was given 6 months' time in which to complete it. The time will expire about June 1, and as yet the piers are not completed. It will require ninety days to complete the structure, and if the county board wishes to enforce the contract the company will be required to forfeit $25 each day from the expiration of the time specified in the contract until the bridge is completed. The company claims that bad weather during the winter almost prevented work from being done. It is probable that the commissioners will grant further time.

Austin, Tex.—The Hardemann-Willbarger Bridge Co. has been incorporated to build a bridge across Red River, at this place. The capital stock is $50,000.

Denison, Tex.—A viaduct will be constructed over the Missouri, Kansas & Texas Ry. on Gandy street. The mayor can give information.

Denison, Tex.—The contract for a foot and wagon bridge, to be built across Red River, distant from Denison three miles, has been awarded to the Missouri Valley Bridge Co., of Leavenworth, Kan. The structure is to cost $50,000. Work will be begun at once.

Shoshone, Ore.—An investigation of the practicability of building a bridge across the Snake River at or near the Great Shoshone falls has recently been made, with the most favorable result. It is estimated that the stream can be spanned by a good substantial structure at two different locations near the falls; at one of these it is claimed about $6,000 will build it and at the other $10,000 will cover the cost.

Goliad Co., Tex.—Jas. A. Burke, Clerk County Court, Goliad Co., Tex., will receive proposals for the construction of three iron bridges, one across Manahuilla Creek, one across Sarco Creek and one across Sparrow Hollow.

Canals.—*Citrus Co., Fla.*—The purchasers of the Florida Orange Canal & Transit Co.'s property have organized with H. W. Martin, of Tompkinsville, president. The canal will be completed to Tompkinsville and on through the entire chain of the Tsala-Apopka lakes.

CONTRACTING.

Fire-Hose.—Baltimore, Md.—The Fire Commissioners, on May 28, awarded contracts for 7,600 ft. of 2½-in. hose and 800 ft. 3-in. hose, distributing the amounts among several companies, as follows: 1,400 ft. each, at 90 cts. per foot, to the Fabric Fire Hose Co., the Baker Fire Hose Co. and the Eureka Fire Hose Co., all of New York; 1,400 ft. cable hose, at 90 cts. per ft., to Janney & Congdon, New York; 1,400 ft. at 87½ cts. to the American Jacket Hose Co., Chelsea, Mass.; 800 ft. of 3-in. hose to the Baker Fire Hose Co. at $1.04 per ft., and 600 ft. 2½-in. 4-ply gum hose, at $1 per foot, to Janney & Congdon.

Sewers.—Baltimore, Md.: Contracts for furnishing materials for the construction of the Dolphin St. sewer have been awarded as follows: To D. Donnelly & Son, hand-made bricks at $8 per thousand and machine-made at $7.50 per thousand; S. M. Hamilton & Co., Cumberland cement, $1.10 per barrel, furnished in bags; C. C. McColghan & Co., Portland cement, $2.80 per barrel; Wm. F. Weller, sewer blocks at $109 per thousand; M. F. Leonard, sand, 70 cts. per cu. yd.

Holyoke, Mass., is about to build a trunk sewer 2,280 ft. long, to cost between $15,000 and $16,000. The material will be brick and vitrified pipe.

Bridge.—The Philadelphia Bridge Works, Cofrode & Taylor, has obtained the contract for the superstructure of the new Susquehanna bridge, near Harrisburg, Pa., for the Harrisburg terminal of the Philadelphia & Reading R. R. The bridge will be nearly 4,500 ft. long with 23 river spans and a viaduct approach through the city of Harrisburg. The approximate amount of iron is 7,500,000 lbs.

Street Paving.—Baltimore, Md.—Contracts have been awarded at the City Commissioner's office for grading, paving and curbing streets, as follows: Washington Ave. from Putnam to Kent St., to James P. McGovern, for grading 22 cts. per cu. yd., paving 5½ cts. per sq. ft., curbing 40 cts. per lin. ft.; the north side of East Baltimore St. at Patterson Park Ave., to A. Schneider & Sons, for grading 18 cts. and paving 6 cts.; Lanvale St. from Harford Ave. to Spring St., to Bergman & Peddicord, for grading 12 cts., paving 5¼ cts., curbing 38 cts.

Milwaukee, Wis., has let contracts for paving Oregon St. to A. Weidner, for sidewalk grading at 22 cts. per cu. yd. and the planking at 27 cts. per lin. ft., while Patrick Drew will do the paving at $1.63 per sq. yd. and the curbing at 58 cts. per lin. ft.

Albany, N. Y., has let contracts for paving Fourth Ave. with granite blocks.

Lighthouse.—The Board of Government Lighthouse Engineers, to whom was referred the petition for a lighthouse at Wilson, N. Y., have made a favorable report for its construction, and it is now in the hands of Congress.

Buildings.—Holyoke, Mass.—G. L. Bosworth & Co. have been awarded the contract for putting in the new stone bulkhead for the Lyman mills corporation. It will be 40 ft. long and 17 ft. high. They will also put in headgates for the Massasoit Paper Co. and a stone floor in front of the drainers of the Nonotuck paper mill.

Troy, N. Y.—James McFarren has been awarded the

contract to build the $12,000 brick addition to the Wynants Kill Knitting Co.'s mill.

Rockville, Md.—The Courthouse Commission opened the bids May 27 for the new courthouse. There were twelve bids in all, ranging from $59,000 to $72,000. As these figures exceed the $40,000 appropriated for the new building, the plans will be reduced and new proposals invited.

Duluth, Minn.—Gideon Boyer, of Marinette, was awarded the contract for erecting the buildings at West Duluth for the Marinette Iron Works. The principal buildings will be two in number, 400x75 and 175x75 ft. in size. They will be built of stone and brick. One-half of the former structure will be two stories high.

Electric Railways.—The Westinghouse Electric Ry. Co. has made several important contracts for railways in Springfield, Mo., and Pittsburgh, Kans. The first contract is for 10 miles of overhead electric-wire railway, with 20 motor cars, and for 2,500 incandescent and 70 arc lights. The other is for 8 miles of electric railway and 10 motor cars, and the lighting by arc and incandescent lights for the new railway to be immediately built in the phenomenal town of Pittsburg, Kan. The parties contracted with are Richard B. F. Holbart, Geo. W. Parker, Lee McNair, and the syndicate of St. Louis capitalists who are investing so heavily in southwestern towns.

Railway Work.—Sub-contractors are wanted with outfits of teams and scrapers, to work on the L. & N. R. R. extension between Sylacauga and Shelby, Ala. Profiles of work can be seen at office in Anniston or Sylacauga. For further particulars apply to McDonald & Campbell, Anniston, Ala.

The New York Department of Docks advertises for bids to be opened June 11, for repairing crib bulkheads at the foot of Gansevoort and other streets, and for dredging at West 34th street pier, North River.

Philadelphia Pa. An ordinance passed by City Councils authorizes the appropriation of $230,000, to be added to the $500,000 voted by the general government for the buying of title to Smith's Island, Windmill Island and other islands, that it may be necessary to remove in order to improve the harbor of Philadelphia. This is the commencement of an important and costly piece of work long discussed.

PROPOSALS OPEN.

Bridge.—For constructing a masonry bridge on the Cincinnati and Hamilton pike, one mile north of Mt. Healthy; in accordance with plans and specifications. Arthur S. Hobby, C. E., Cincinnati, O. June 9.

Pumping Plant.—Supplying, setting in place, and delivering in complete working order the pumping plant in connection with the dry dock, now being constructed. A. Gobeil, Secretary Department of Public Works, Ottawa, Ont. June 27.

Court House.—Three-story stone and granite court house. Joseph Ehlinger, County Clerk, Lea Grange, Ga. June 24.

Railway Construction.—Forty miles of clearing, grubbing, grading and bridging from deep water at Olympia to Union City, on Hood's canal. June 15.—Forty miles of similar work on the west bank of Hood's canal, from Union City north. July 15. F. A. Hill, Chief Engineer and Superintendent of construction, Seattle, Wash.

Sewers.—Estimated cost, $1,000,000. Commissioner Adams, Brooklyn, N. Y. June 11.

Bridges.—Frank J. Reinhard, County Auditor, Columbus, O. June 14 and 30.

Street Work.—Frank H. Cooper, City Engineer, Terre Haute, Ind. June 17.

Vitrified Brick Pavement.—About 5,970 sq. yds. of paving and 3,125 lin. ft. of curbing. F. W. Dalrymple, City Engineer, Bradford, Pa. June 16.

Highway.—Alexis H. French, C. E., Brookline, Mass. June 9.

Macadamizing.—Furnishing bed rock and macadamizing 1¼ miles of county road. Thomas Finn, Clerk, County Court, Moundsville, W. Va. June 16.

Sewers.—John A. Coleman, Commissioner of Public Works, Providence, R. I. June 16.

City Hall.—Estimated cost, $25,000. City Clerk, Urbana, O.

Bridge.—One 100 ft. span bridge. F. J. O'Flaherty, County Surveyor, Water-Works Bldg, Kansas City, Mo. June 16.

Brick School House.—C. C. Emswiler, Secretary School Board, Peru, Ind. June 17.

Bridge.—Building an iron and stone bridge over the lake near Breeze Hill, Prospect Park. Robert Courtney, Secretary, Brooklyn, N. Y. June 9.

Arch.—Cost, $900. Olin W. Timmerman, Village Clerk, Little Falls, N. Y. June 10.

Street Work.—F. M. Seuter, City Clerk, Columbus, O. June 11.

Sewers.—F. M. Seuter, City Clerk, Columbus, O. June 11.

Macadam.—For furnishing and delivering macadam for one year. George Burnet, President Board of Public Works, St. Louis, Mo. June 24.

Steel Boilers.—Furnishing all the materials and labor necessary to construct and place on board the light-house tender Lily, two steel boilers. C. S. Cotton, Commander U. S. A. Light House Inspector 15th District, St. Louis, Mo. June 25.

Artesian Well.—Boring to a depth of 2,000 ft., unless a satisfactory flow is obtained sooner. Well to be not less than 6 ins. in diameter at the bottom. William Shelton, Mayor, Marlin, Tex. June 15.

Sewers.—W. A. Wadsworth, President Board Sewer Commissioners, Geneseo, N. Y. June 20.

Light House.—Furnishing material and labor required for the Marquette Breakwater Light Station. William Ludlow, Light House Engineer, Detroit, Mich. June 13.

Water Bonds.—Amount, $400,000; 40-year 4 per cent G. N. Ducharme, Treasurer, St. Cunegoude, Montreal, P. Q. June 25.

Bridges.—For building three iron bridges in Goliad Co One across Manhuilla Creek, one across Sparrow Hollow and one across Sarco Creek. All in accordance with plans and specifications on file. James A. Burke, Clerk C. C., Goliad Co., Tex. June 12.

Water Bonds.—Amount, $100,000; 20 year 4½ bonds. D. B. Varney, Mayor, Manchester, N. H. June 18.

Granite Paving Blocks.—Quantity, 1,500 sq. yds. J. D. White, Clerk of the Selectmen, Chicopee, Mass. June 16.

Artesian Well.—Depth, 2,500 ft., unless a satisfactory flow is obtained sooner; 8 ins. in diameter at the bottom. J. F. Stout, Mayor, Corsicana, Tex. June 20.

Bridge.—To carry a 16-in. water pipe over the Buffalo River, on Seneca St. Water Commissioners, Buffalo, N. Y. June 18.

Water Pipe.—A 16-in. water pipe to be laid on a bridge over the Buffalo River. Water Commissioners, Buffalo, N. Y. June 18.

MANUFACTURING AND TECHNICAL.

New Corporations.—The Tennessee River Construction Co., at Chicago, to build railroads; capital stock, $300,000; incorporators, T. J. Moss, B. F. Hobart and J. W. Phillips.

Chicago Heat Storage Co.; to manufacture appliances for producing storage heat; capital stock, $60,000; incorporators, C. G. Singer, F. W. Melick and John Le Boutillier.

The Automatic Machine Co., at Chicago, to manufacture and control devices; capital stock, $35,000; incorporators, E. W. Ellis, G. W. Griffin and P. A. Schriver.

Keokuk, Ia.—A company is being organized to be known as the Keokuk Hydraulic and Electric Power Co., with a capital of $500,000, the object of which is to utilize the immense water power available from the Des Moines rapids in the river at that point.

Cars.—New Orleans.—John Klein, S. P. Walmsley, E. L. Simonds and others, have incorporated the Goelet Automatic Car Coupler and Manufacturing Co., to manufacture the Goelet automatic car coupler. The capital stock is $200,000.

The Southern Transportation Co. is being organized, in Atlanta, Ga., to build 1,000 Riordan refrigerator cars to transport fruit, etc., north, and to bring beef and other perishable articles south. The Riordan Refrigerator Car Co. built the cars used on the banana trains running from Tampa to Chicago. The temperature is regulated at will down to 45° F., and the 1,400 mile trip is made without ice. The East Tennessee railway also uses 100 of these cars in the melon trade. The cars cost $850 each, and on a mileage basis of ¾ cents, earn about $20 per month the year round. They are guaranteed by their makers for 10 years. The banana trains referred to average in the year a mileage of 3,000 miles per month.

The Pardee Car and Machine Works, of Watsontown, Pa., have just completed the construction of 250 box cars, of 50,000 lbs capacity, equipped with Westinghouse air brakes and Gould automatic couplers for the Central of New Jersey, and are now constructing a number of the newly designed 60,000-lb. capacity hopper gondola coal cars for the Beech Creek road. These latter cars will also be equipped with the Gould coupler.

The American Fire-Proof Car Co. is to build works at Bridgeport, Ala., with a capital of $1,500,000, and a monthly capacity of 235 steel clad freight cars and 25 passenger cars.

Steam Road Roller.—Woonsocket, R. I., has purchased an Aveling & Porter steam road roller.

A Water and Gas-Pipe Foundry is to be built in Denver, Col., the first of its kind there.

The Deane Steam Pump Co., of Holyoke, Mass., offers its foundry property for sale, including a brick foundry building 150 x 80 ft.; brick pattern shop, 80 x 40 ft., and storage sheds 120 x 20 ft. The Deane Co. is building a new factory in Holyoke and will soon vacate those spoken of.

The Vulcan Iron Works, at Wilkesbarre, have on hand now one of the largest pairs of first motive hoisting engines ever made. They are for the Delaware & Hudson Coal Co., and will be used at the Conyngham mine, at Wilkesbarre. They are 600 horse power, and with an 18-ft. drum will hoist a carriage up a 600-ft. shaft in 12 seconds.

The Dickson Manufacturing Co., at Scranton, has lately turned out a very difficult casting, a cylinder for a steamer in South American waters. The first attempt was successful. The bore of the cylinder is 42½ ins.; the casting is 7½ ft. high. The cylinder itself is forced into a jacket, which also forms the steam chest and part of the receiver. The total weight is 26,750 lbs.

The South Boston Iron Works has completed arrangement to build at Middlesborough, Ky., a branch factory for making pneumatic gun carriages, chilled steel projectiles and armor plate. The plant will cost $500,000 and the works will employ 500 men.

Chicago Columbus Tower and Construction Co., at Chicago; capital stock, $2,000,000. Incorporators: M. B. Bailey, Bernard McDevitt, Julius Jones, John Kelly and P. C. Harbour.

Wolf & Davidson Dry Dock Co., of Milwaukee, capital stock, $250,000. Incorporators: William H. Wolf, Thomas Davidson and Frank L. Vance.

The Steele Safety Signal Co., at Chicago, to manufacture railway signals; capital stock, $250,000. Incorporators: J. W. Steele, W. F. Waite and G. D. Cook.

A broken stone company, of which Michael Dady, of Brooklyn, and Louis Payn and James W. Husted, of Peekskill, N. Y., are members, has been organized. The company has secured the contract for putting 16 ins. of broken stone on the bed of the New York Central & Hudson River R. R. all the way from New York to Buffalo. It will take seven years to complete the railroad contract. When in full operation the company will employ about 500 hands.

The Asphalt e Slag Paving and Roofing Co., of 45 Broadway, N. Y., President General Fitz John Porter, have established works at Newark, N. J., for the manufacture of their new paving and roofing material. Furnace slag, from gold, silver, copper and lead reduction works, is the basic material of the asphalt compound used. This is moulded under heavy pressure into 18 × 18 in. blocks 2 to 6 ins. thick. The upper edge is bevelled, and the V-shaped trough is filled in with the same composition after the pavement is laid, so as to practically form a monolithic sub-pavement. The wearing face is made in same sized blocks but only 2 ins. thick, and of heavier particles of slag. The advantages claimed are cheapness, noiselessness, durability and cleanliness. Wooden blocks imbeded in the two asphalt layers are arranged to secure elasticity, economy in reducing amount of asphalt and in increased strength and prevention of cracking.

Locomotives.—The Schenectady Locomotive Works are building a second compound engine for the Michigan Central. They have also received an order for 75 locomotives from the New York Central. An additional boiler shop, 76 x 134 ft., is being built. An engine has just been turned out for the Hutchison & Southern R. R. Co.

The Mt. Clare shops of the Baltimore & Ohio R. R., for the past year engaged in repair work only, are about to commence the construction of locomotives again. Work will commence on 35 heavy freight locomotives shortly. About 2,000 men are now on the Mt. Clare pay rolls, and this number is to be increased. The company is to add 3,000 freight and hopper cars to the rolling stock of its main line.

The Rogers Locomotive Works is building a mogul freight engine for the New Jersey & New York R. R.

The Strong Locomotive Co. have about concluded negotiations with Mr. Matthew Addy, and it is now believed that they will build their works at Addyston, and not at Essenton, as some hoped.

The Idaho Division of the Union Pacific R. R. has ordered two 112-ton engines for use between Camas and Monida.

An Electrical Engine Headlight is soon to be tried on the Connecticut River R. R. Instead of connecting the engine by wire with the motor in the baggage car, a storage battery will be used, the light being of about 25-candle power. The principal difficulty lies in the liability to breakage of the battery.

Metal Market Prices.—*Rails*—New York: $30.50, old rails, $24.00 to $24.50 for iron, $19 to $19.50 for steel. Chicago: $35; old rails, $23.50 for iron, $21 for steel. Pittsburg: $31 to $32; old rails, $25.50 for iron; $20 to $20.50 for steel.

Foundry Pig-iron.—Chicago: $15 to $15. Pittsburg: $17 to $18. Birmingham, $12.50. New York: $18.

Track Materials.—New York: steel angle bars, 1.75 to 1.80 cts.; spikes, $2 to $2.10; track bolts, 2.8 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.80 to 1.90 cts. for iron; spikes, 2.05, or 2.15 cts. delivered at Chicago or St. Louis; track bolts, 2.85 to 2.90 cts., with square, and 2.95 to 3 cts. with hexagon nuts. Chicago: splice bars, 1.90 to 2.20 cts. for steel, and 1.95 to 2.05 cts. for iron; spikes, $2.05; track bolts, 2.90 to 3 cts., with hexagon nuts.

Pipe.—Cast-iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York 4.35 cts.; Chicago, 4.20 to 4.25 cts.; St. Louis, 3.75 cts.

Structural Material.—Pittsburg: angles, 2.25 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared steel bridge plates, 2.75 cts.; universal mill plates, 2.40 cts.; refined bars, 1.90 to 2 cts.; steel plates, 4.25 to 4.75 cts. for firebox; 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.75 cts. for tank.